

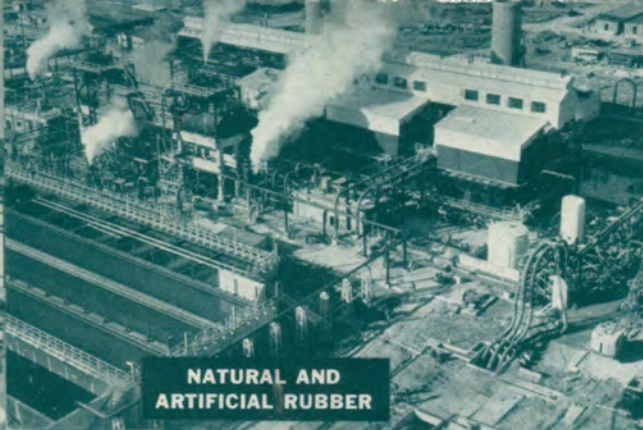
BUILDING A BOILER



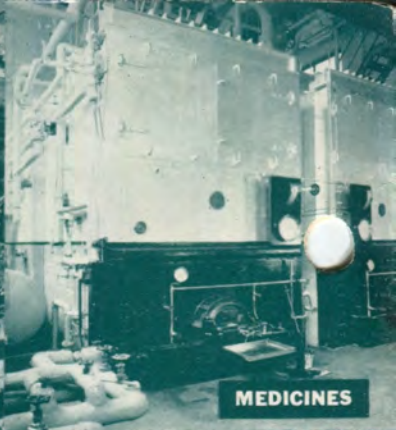
BABCOCK & WILCOX



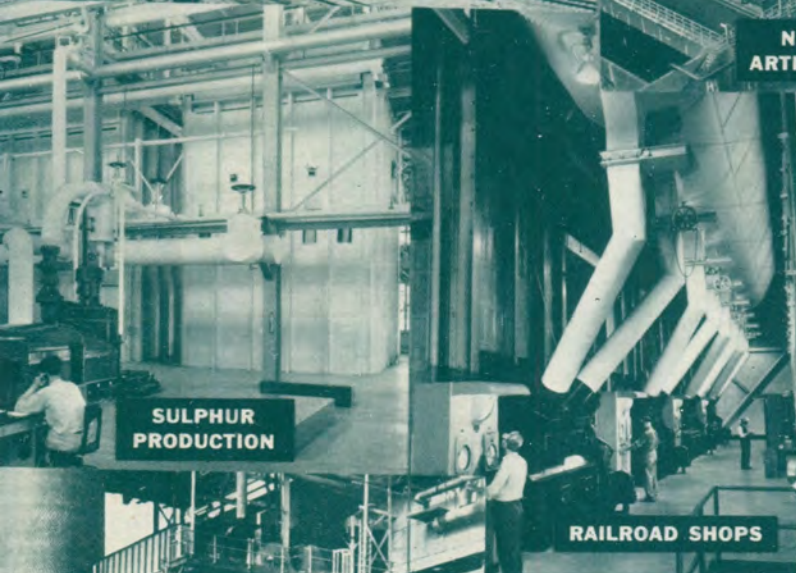
CHEMICALS



**NATURAL AND
ARTIFICIAL RUBBER**



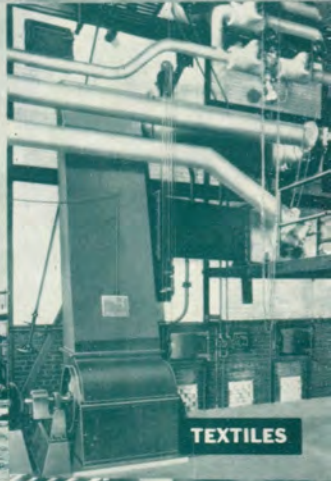
MEDICINES



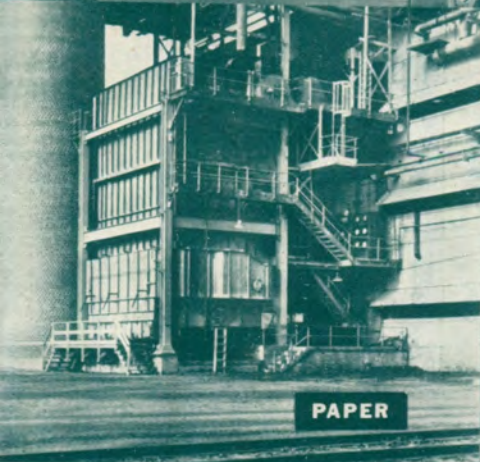
**SULPHUR
PRODUCTION**



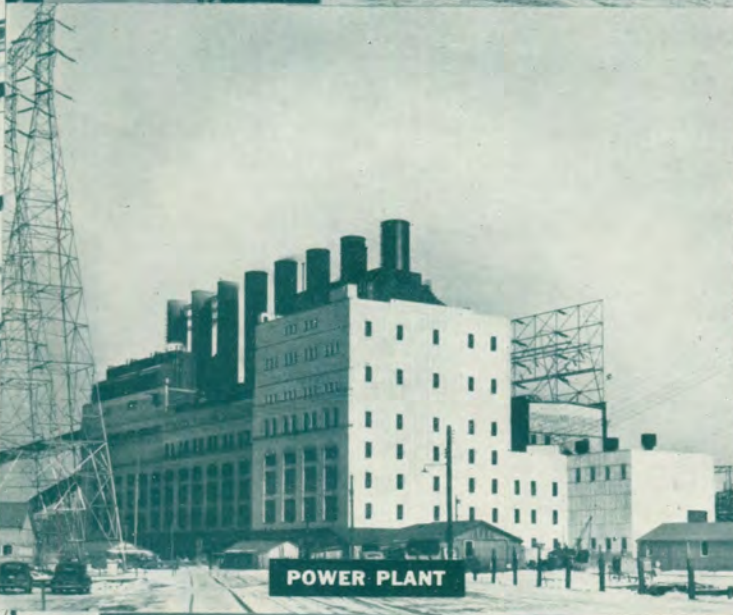
PETROLEUM



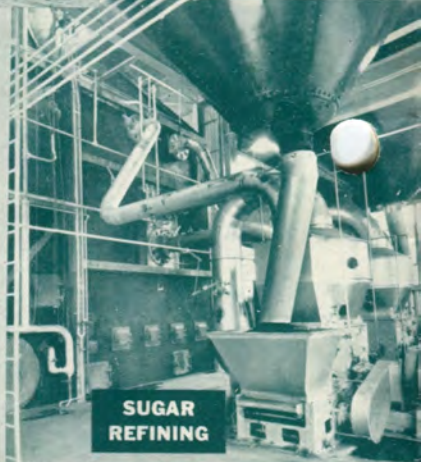
TEXTILES



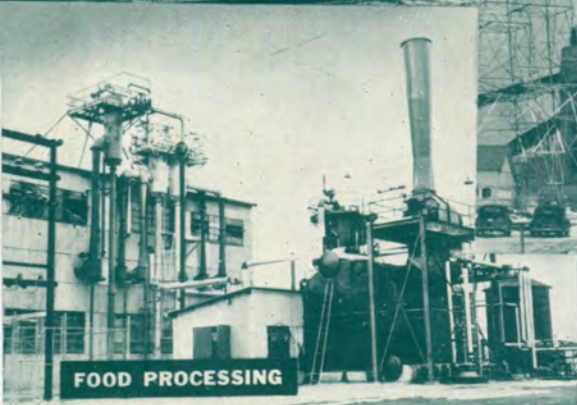
PAPER



POWER PLANT



**SUGAR
REFINING**



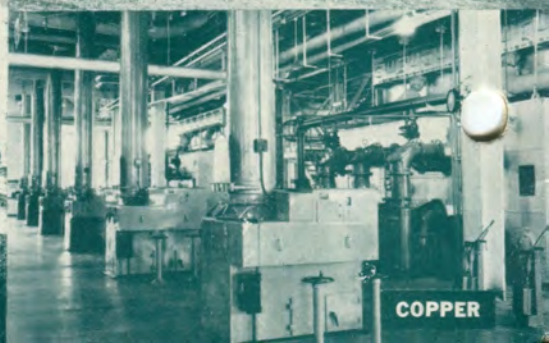
FOOD PROCESSING



STEEL



SEAPOWER



COPPER



TIMBER

Steam and Power

From the earth comes the fuel—coal, oil, gas—and through the medium of steam it is used to create the things that make us a powerful nation:

ELECTRICITY—A flip of the switch—and we have electric power at our command. Today, the roar of our industrial complex, the hum of farm activity, the pace of home life—all are synchronized with a great network of steam-electric generating stations.

PETROLEUM—Lubricants, gasoline, heating fuels and many other products—all are necessary for industry, transportation and health. Refineries must have steam available quickly and in large quantities to produce these essential materials from crude oil.

CHEMICALS—Everything we use has been touched by the magic of chemistry—and this great industry is a prodigious user of steam for power and processing.

SEA POWER—Giant battleships and aircraft carriers, speedy transports and tankers—the bulk of our great sea power is driven by steam.

MEDICINES—Both in peace and in war, our increasing stores of new medicines save countless lives, ease pain and suffering. Without steam, production of many essential medicines would be impossible.

RUBBER—Not until it is scarce do we fully understand the importance of rubber to our economy. Rubber production, whether natural or artificial, demands great quantities of steam.

FOOD—Abundant food lines the shelves of the corner grocer, and most of it has been processed safely, quickly, and inexpensively through the medium of steam.

TEXTILES—Whatever we wear, natural fiber or synthetic, civilian clothes or "Government Issue", steam is an essential element in its manufacture and in its cleansing.

METALS—Whether it is steel, copper, aluminum or some other basic metal, steam is indispensable to its production—either as a means of supplying power or in one or more of the processing steps from raw ore to finished product.

MUNITIONS—From sulphur extraction to humidity control in explosives plants, steam is needed at almost every step in this vital industry.

Whether it is generating electricity, powering a ship, or making steam for industry, today's steam plant is a symbol of efficiency. The boiler is the means by which the heat released by burning fuel is converted into steam, and in this booklet we would like to tell you something about how a modern boiler is conceived, fabricated and erected.

What does a boiler do?

A boiler utilizes the heat from fuel to convert water into steam—often at very high pressures and temperatures. It is essentially a large water-cooled structure, absorbing heat from the fuel burned inside it. Together with its immediate auxiliaries, it is designed to perform most economically the following functions:

1. Prepare the fuel for combustion
2. Burn the fuel efficiently
3. Absorb the resulting heat, so that a minimum is lost to the atmosphere
4. With the heat thus absorbed, generate steam at the required pressures and temperatures

The three most common fuels are coal, oil, and gas, but many others are used. Lignite, for example, is assuming ever greater importance in certain parts of the country. Industrial and food-processing by-products—wood, bark, sugarcane stalks, paper-making chemicals, blast-furnace and coke-oven gas—all are used to generate steam.

The steam generated in the boiler tubes is at a certain temperature depending on the pressure. This temperature may be sufficient to carry out the process for which the steam is being used. Very often, however, when driving turbines or taking part in certain chemical processes, the steam must be heated to very high temperatures—so high that the pipes carrying it glow red. To achieve these high temperatures, superheaters are installed at the proper point in the stream of hot gases to absorb the necessary heat.

After the gas from the burning fuel has passed across the boiler and superheater tubes, it still contains considerable heat. In most cases, particularly when fuel costs are high, it is economical to add more devices to absorb this heat. This is done with economizers and air heaters. Relatively cold feedwater flows through the economizer tubes, on its way to the boiler, and can absorb much heat. Similarly, the air for combustion is blown across the air heater tubes and the heat it picks up is returned to the furnace.

While the illustration on the opposite page shows the functioning of a large power boiler using pulverized coal as its primary fuel, the basic principles are the same for all water-tube boilers and any fuel.

6. Steam flows from drum to **SUPER-HEATER**, consisting of tubes often containing many alloys. The hot gas flowing over these tubes heats the steam to very high temperatures. The higher the temperature and pressure, the more power the turbine delivers for each pound of steam. Sometimes partially spent steam is returned from the turbine to **REHEATERS**, to pick up more heat and further increase efficiency.

7. Cold feedwater enters the **ECONOMIZER**. It picks up heat from the combustion gas before entering the steam drum.

8. The gas still contains valuable heat. The air used for combustion of the fuel is blown through the **AIR HEATER** and absorbs this heat. The hotter the combustion air, the more efficiently the coal is burned. Absorbing as much heat as possible means we can burn less coal.

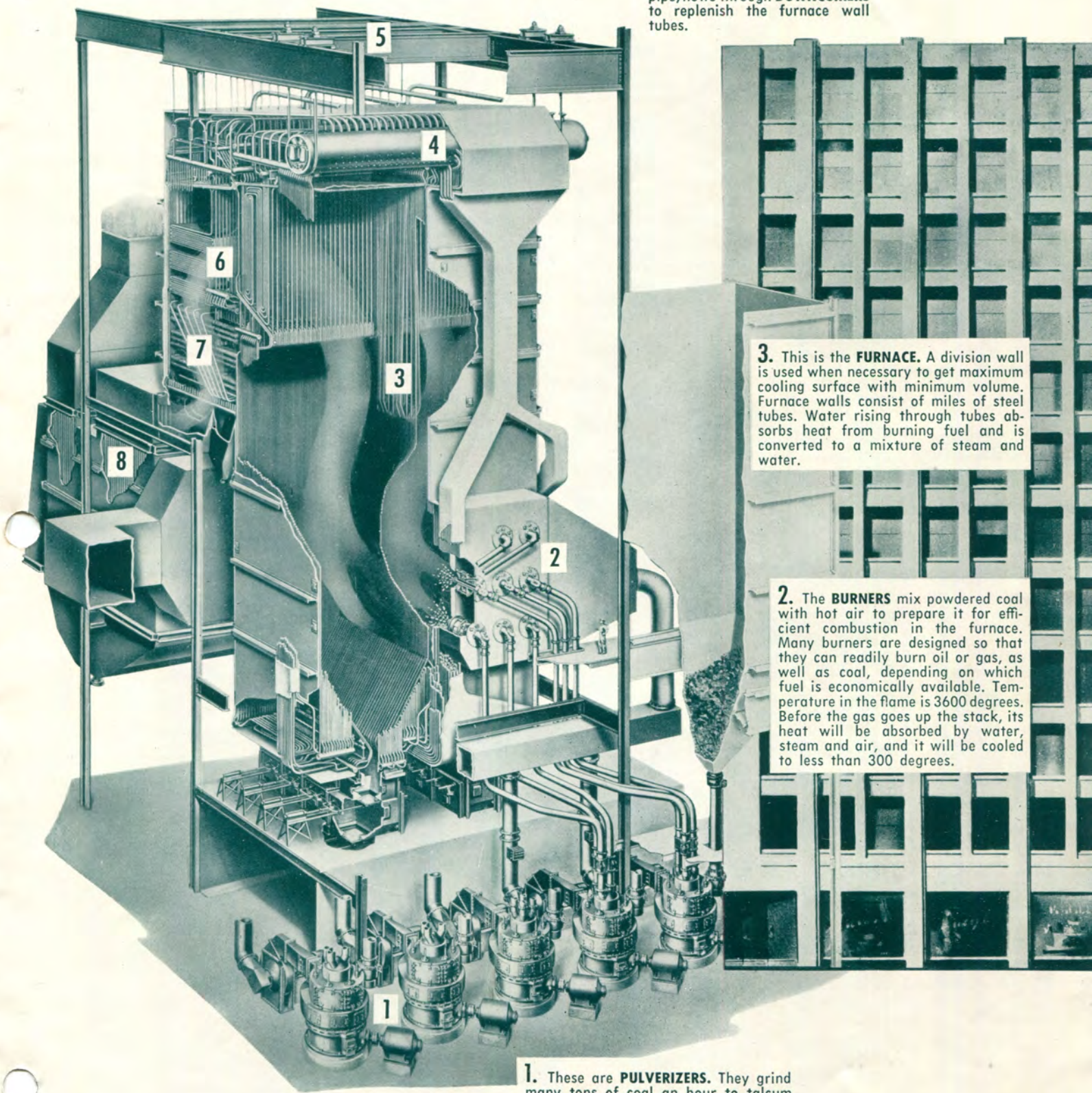
5. The entire boiler is **SUSPENDED** from beams high in the air. This requires a minimum of supporting steel for the boiler, and lets the unit expand and contract uniformly.

4. Steam-water mixture is separated in the **STEAM DRUM**. Separated water, joining with other water entering through the feed pipe, flows through **DOWNCOMERS** to replenish the furnace wall tubes.

3. This is the **FURNACE**. A division wall is used when necessary to get maximum cooling surface with minimum volume. Furnace walls consist of miles of steel tubes. Water rising through tubes absorbs heat from burning fuel and is converted to a mixture of steam and water.

2. The **BURNERS** mix powdered coal with hot air to prepare it for efficient combustion in the furnace. Many burners are designed so that they can readily burn oil or gas, as well as coal, depending on which fuel is economically available. Temperature in the flame is 3600 degrees. Before the gas goes up the stack, its heat will be absorbed by water, steam and air, and it will be cooled to less than 300 degrees.

1. These are **PULVERIZERS**. They grind many tons of coal an hour to talcum powder fineness. The powdered coal is picked up by a stream of heated air and blown through the burners into the furnace.



Many types of

Because the uses to which steam is put are so varied, and because there are so many different kinds and grades of fuel, the boilers which generate steam are of many types and sizes. They range from giant Radiant Boilers, ten or fifteen stories high, to small FM units, that can be shipped complete on a trailer truck, but one common feature applies to all: the ability to supply steam economically and dependably.

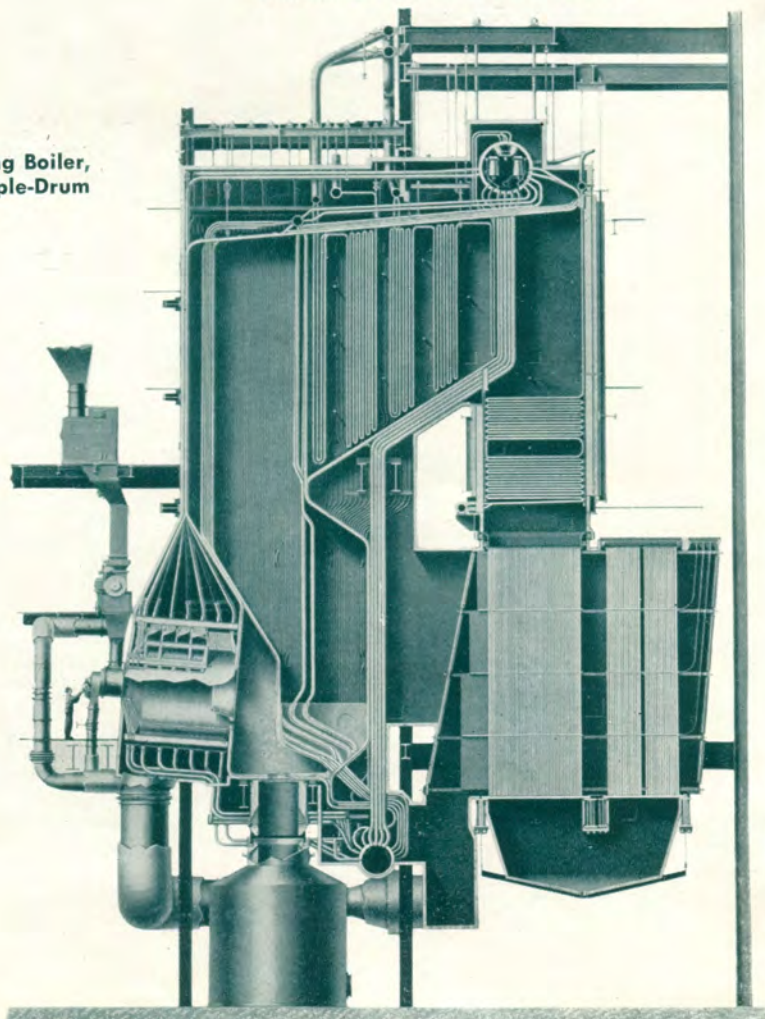
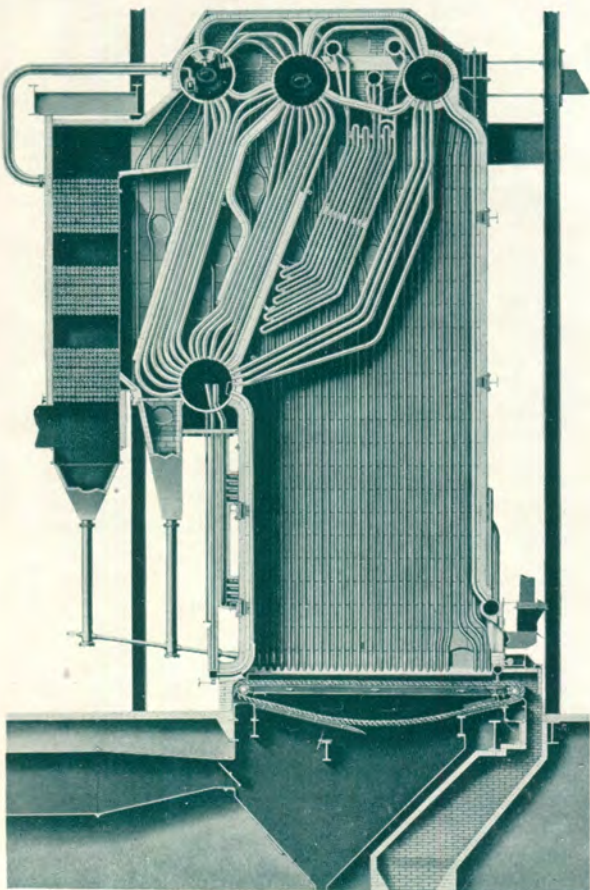
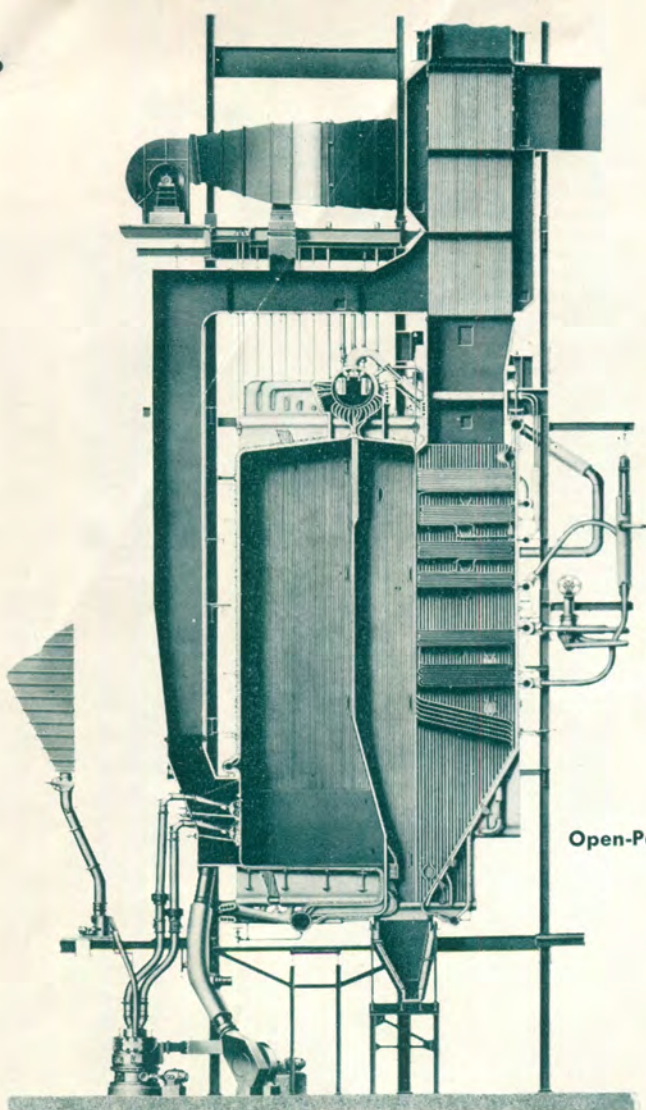
Radiant and Open-Pass Boilers are used in steam-electric power stations and large industrial plants. Some now in operation generate over 1,400,000 pounds of steam per hour. Design pressures exceed 2700 pounds per square inch, and steam is delivered to the turbine at temperatures over 1000 degrees. Many of these boilers consume over twenty carloads of coal in one day.

Stirling Boilers, both Multiple-Drum and Two-Drum types, are used for intermediate steam requirements.

Open-Pass Boiler

Radiant Boiler with Cyclone Furnace

Stirling Boiler,
Multiple-Drum
Type

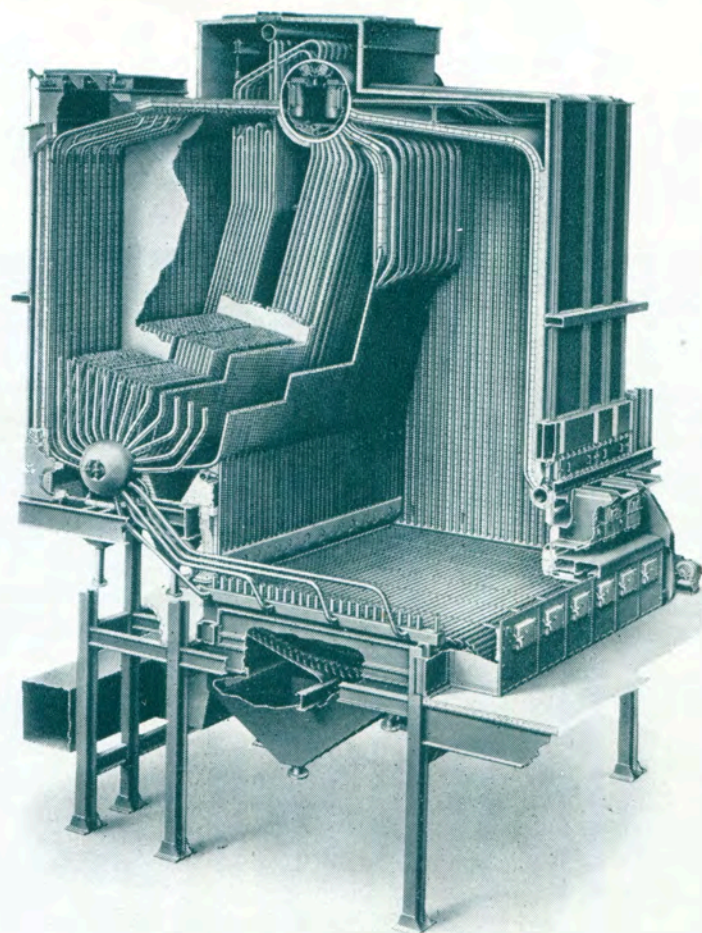


boilers are needed

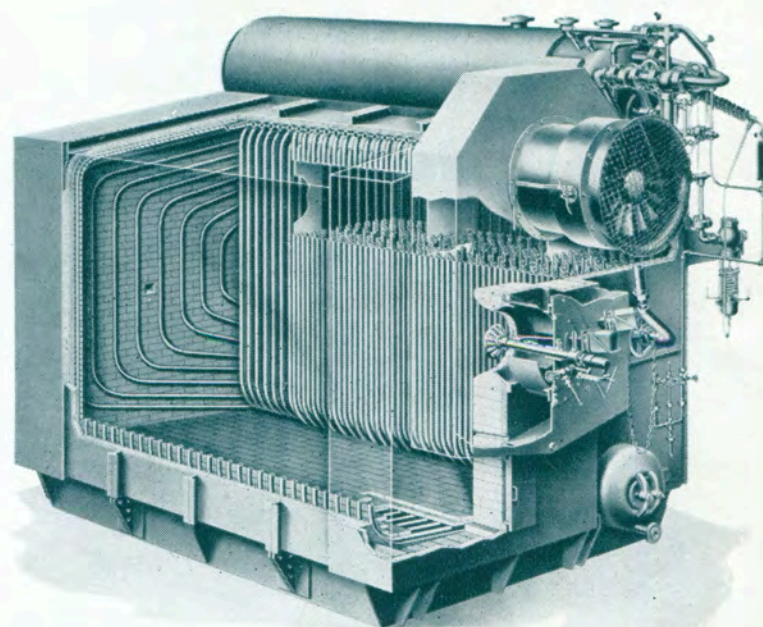
They are noted for their ability to meet sudden load swings over unusually wide ranges of operation, and to produce clean, dry steam with relatively impure water conditions.

The Integral-Furnace Boiler is used throughout industry and comes in many different types, for steam requirements ranging from as high as 350,000 pounds of steam per hour to as low as 3000 pounds per hour. They are adaptable to a variety of fuels and most types come equipped with superheaters. The type FH is used for the higher steam requirements and the compact FM type is used in small plants requiring a package unit that can be shipped completely assembled, ready to hook up and operate. The FL Integral-Furnace Boiler is one of the widely used intermediate types.

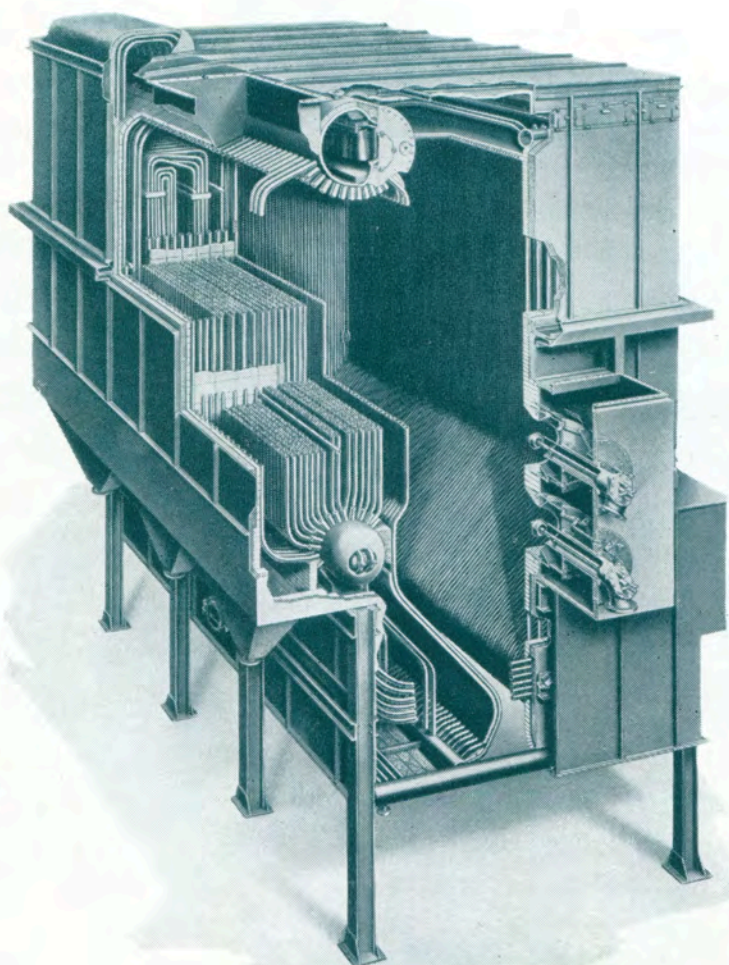
Marine Boilers require special attention to compactness and weight and must be designed to withstand the difficult conditions of operation at sea and in port. A single ship will often have packed into it enough power supply all the electrical needs for a city with a population of several hundred thousand.



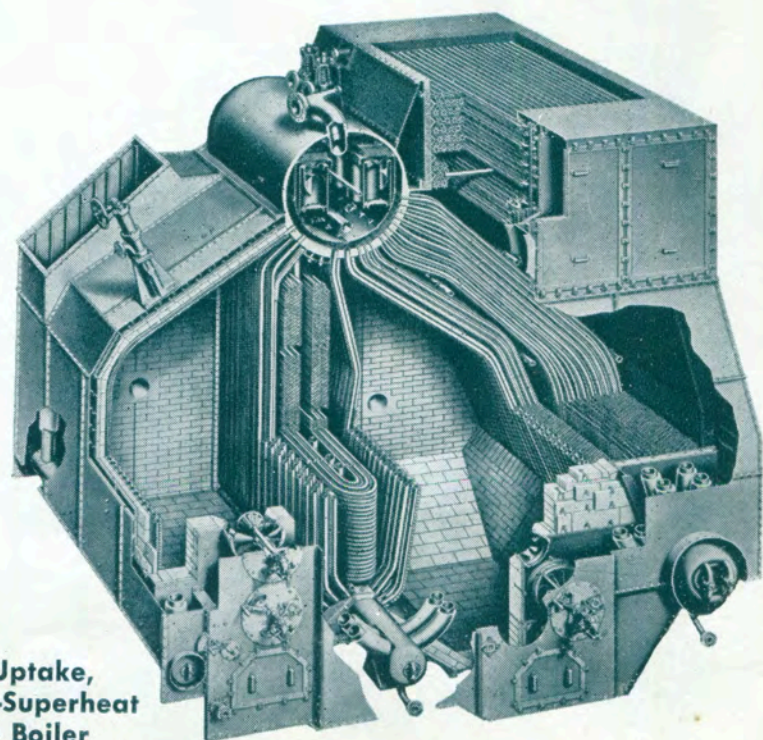
Integral-Furnace Boiler, Type FL



FM Package Boiler



Integral-Furnace Boiler, Type FH



**Single-Uptake,
Controlled-Superheat
Marine Boiler**

Tons of material are



A boiler consists of hundreds of parts, made of steel, and alloys of nickel, chromium, molybdenum, titanium, tungsten, and many other materials. Here are some of the many materials needed to build just *one* average size power boiler:

2500 Tons of Carbon Steel

60 Tons of Carbon-Molybdenum Steel

190 Tons of Chromium-Molybdenum Alloys

25 Tons of Chromium-Nickel Alloys

And *hundreds of boilers* are needed for the ever expanding needs of utilities and industrial plants. The design and integration of these raw materials into a structure that can release and control great forces of nature requires the skills of many men.

But before the first tentative pencil marks are made the designers want the answers to some basic questions.

How much steam per hour?

What pressure?

What temperature?

What fuel will it burn?

How much steam sets our overall size. The pressure determines how thick our steel must be. The temperature often dictates what alloys must be used. The answer to all three determines how much fuel must be burned. The kind of fuel very often has an overriding effect on design.

Coal is our most abundant fuel, but its quality varies. To generate steam most efficiently and economically

ILLUSTRATIONS: (top to bottom)

- Loading boiler parts
- Material receiving yard
- Engineering conference
- Coal shipment

used to build a boiler

from available coals having a broad range of characteristics, special considerations of design are necessary.

Thousands of manhours must be spent in engineering, in detail design, in drafting, before materials can be ordered and fabrication started.

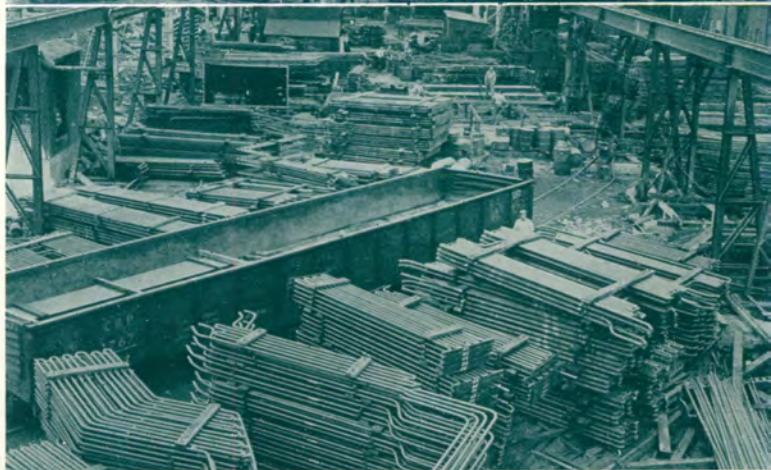
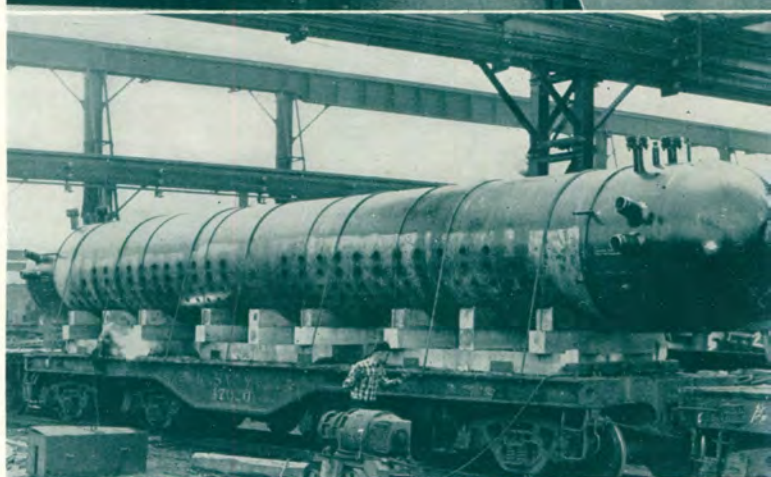
The total elapsed time, from start of design work to completion of erection may be as long as two years, particularly for large power boilers. Users of steam must therefore be able to chart their needs well in advance.

Because of their size, boilers are generally shipped in parts and assembled at the site. Fabrication of the thousands of items needed must therefore be carefully planned, so that each component can be completed and shipped in orderly sequence.

Once erection begins it must progress rapidly and efficiently. Thus, a steady stream of materials is delivered to the plant site. Parts which must be temporarily stored outdoors are specially treated to protect them from the elements.

In the early stages, detailing work is rushed on those materials which will be needed first in the erection process, or which will have the longest fabricating time. The lack of certain materials, no matter how small the quantity, could hold up completion of an entire unit, and delay ultimate production of essential steam for power or processing.

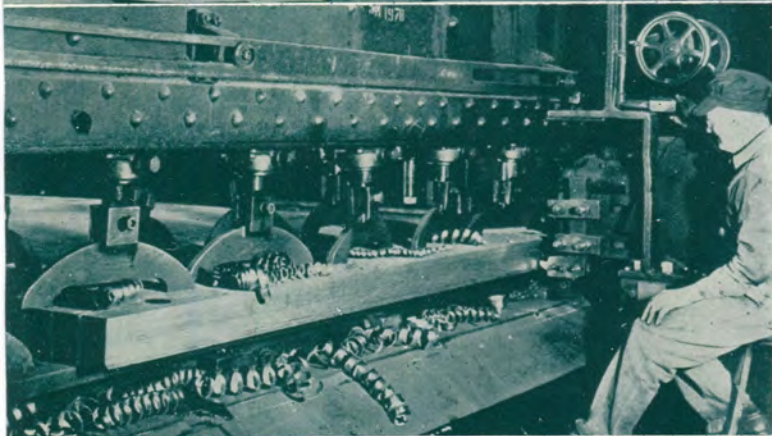
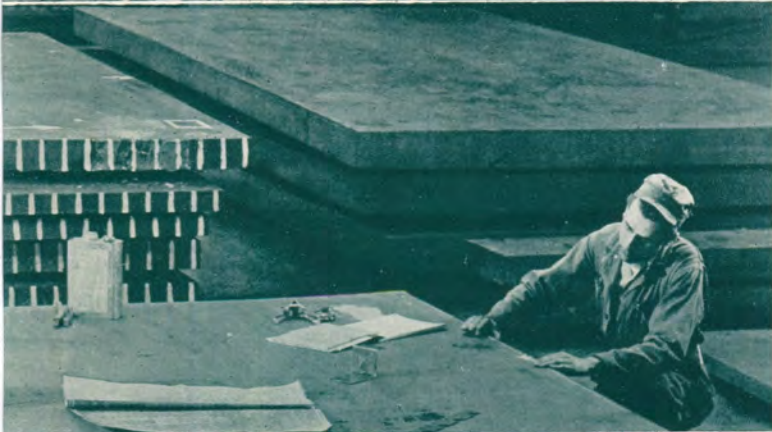
Planning and scheduling at every step of the way are essential requirements, and the men responsible must have thorough knowledge of all phases of design, manufacture and construction.



ILLUSTRATIONS: (top to bottom)

- Drafting room
- Shipping steam drum
- Shipping yard
- Production control board

Many skills are called upon



Building a boiler is a job that begins simultaneously in many different hands, requires many different skills. Before the hundreds of tons of steel and alloys can begin to perform their vital work of making steam, they will be subjected to a multitude of operations—heating, forging, rolling, machining, welding, piercing, drilling, x-raying—and all the countless processes by which man has learned to shape raw materials into the machines that serve him.

Fabricating drums is an exacting process. The steel for steam drums is often more than six inches thick, and *one* drum may use over 200 tons of steel. That's a lot of steel, but thanks to engineering improvement, it is a great deal less steel than would have been required for the same job ten or fifteen years ago.

The steel slabs are thoroughly inspected and then marked for machining and rolling.

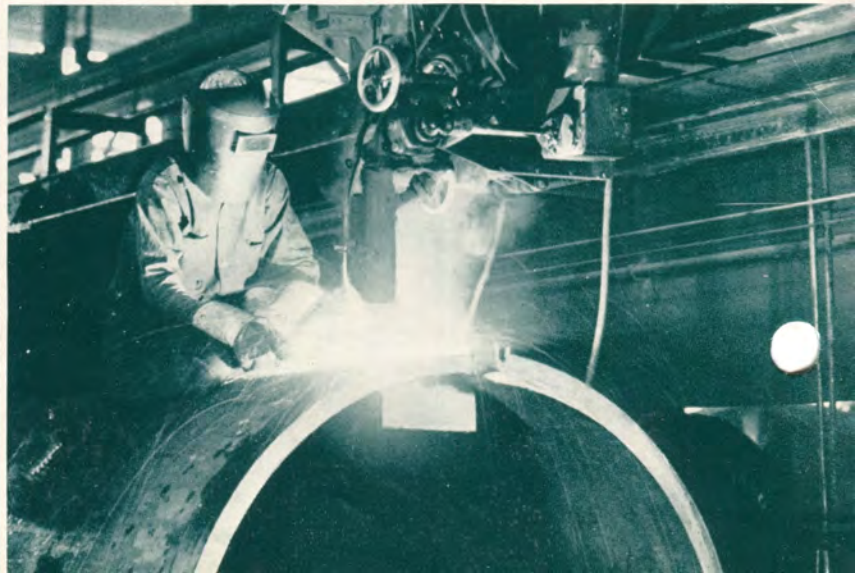
After proper heating, the huge slab is rolled to the required diameter. Despite the great power required to bend such thick pieces of steel, the rolls are so exactly controlled that the plate is formed into a nearly perfect circle.

The seam in the drum is welded by automatic machines. Later, the drum heads and various nozzles will also be attached by welding.

ILLUSTRATIONS: (top to bottom)

- Drum fabricating shop
- Marking drum plate
- Machining thick plate
- Rolling drum

(Below)—Welding longitudinal drum seam



to build drums

Whether the drum plate is many inches thick, to withstand pressures as high as 2700 pounds per square inch, or less than one inch thick for low pressures, exacting care is the keynote at every stage in its transition from flat steel to completed drum.

Weld seams are examined by means of x-rays. A 2,000,000-volt machine makes it possible to obtain clear pictures of thick welds rapidly and accurately. Because of continuous improvements in welding and x-raying techniques, drums can now be made safely for higher pressures than ever before possible.

The heads to close off the ends of the drum are forged from round slabs. Proper temperature control is important to insure correct properties in the finished head.

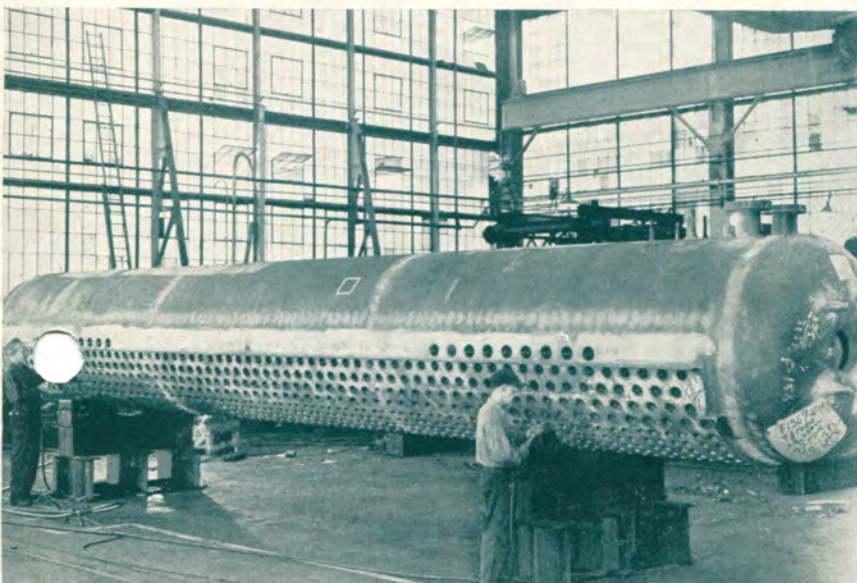
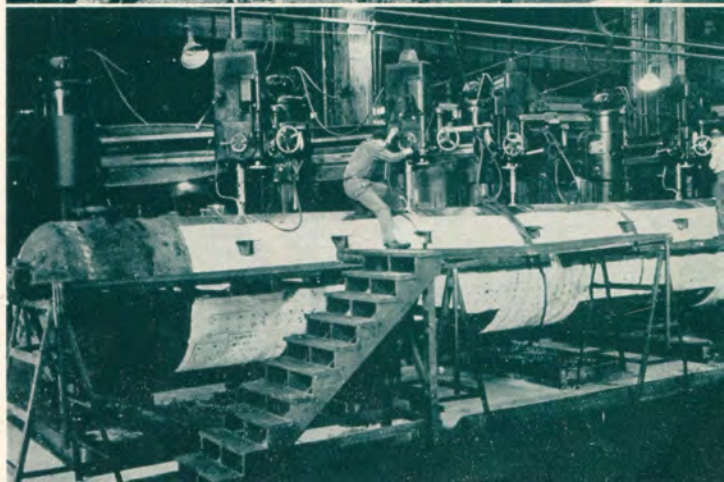
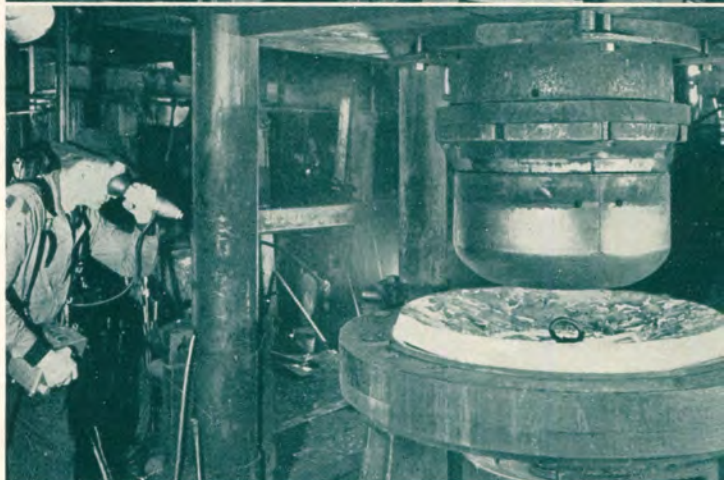
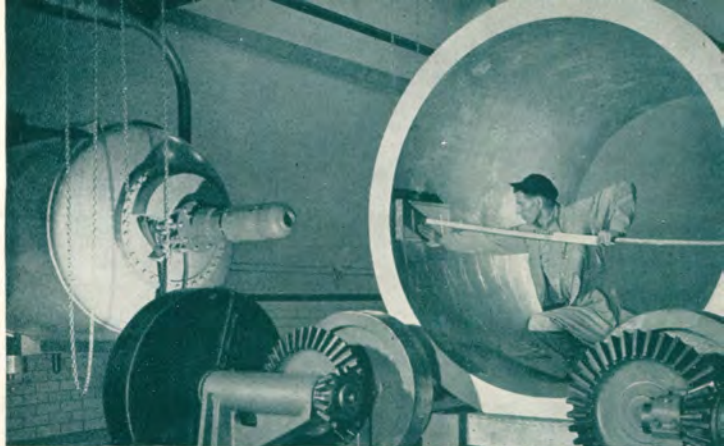
The head must be machined so that it can be welded to the drum. High speed cutting tools are geared to do the job quickly and accurately.

Drilling thousands of tube holes in the drum is done by precision machinery. Despite the thickness of the steel, the holes are drilled rapidly and to very close tolerances. After drilling, tube holes are reamed, machined, and grooved so as to provide a good seat for the tubes that will be inserted in the field.

ILLUSTRATIONS: (top to bottom)

- 2,000,000 volt x-ray machine
- Pressing drum head
- Machining drum head
- Drilling tube holes

(Below)—Cleaning tube holes



Miles of tubing

Over 80 miles of tubing of all types may go into a large boiler. Thousands of feet are used to make up the furnace walls, and considerable amounts of alloys are used in the superheater tubes, where steam is heated to the high temperatures needed for good efficiency. Economizers and air heaters also require tons of tubing to extract valuable heat from combustion gases before they pass out the stack.

Tubes are fabricated in highly specialized shops, and pour in an endless stream from batteries of production lines that start with the making of the steel itself.

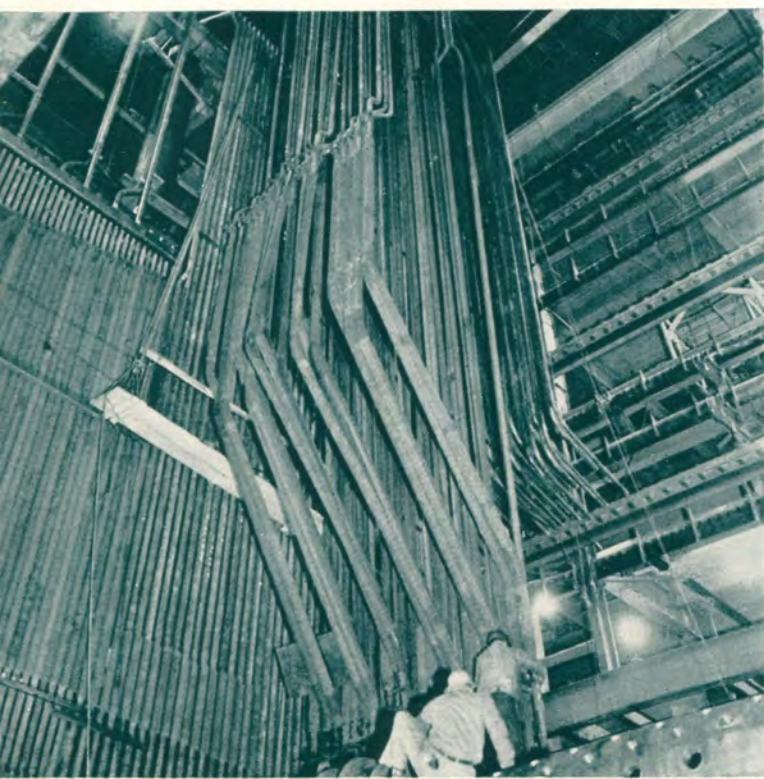
Tube "rounds"—solid cylinders of steel—are the basic requirement in making seamless tubes. For carbon steel tubing, open hearth steel is generally used. For the alloy steels needed in superheaters, the ingredients are melted down in electric furnaces and poured into ingots. These then pass through a series of forging and blooming operations to make the tube rounds.

Piercing the tube rounds is as much art as science. Tough alloy steels, in particular, require a unique combination of technical knowledge and practical skill. The tube round is precisely heated, for best piercing can be done only in a narrow temperature range for each

ILLUSTRATIONS: (top to bottom)

- Furnace wall and screen tubes
- Tube round shop
- Pouring electric furnace steel

(Below)—Piercing billet for seamless tubing



must be fabricated

particular kind of steel. The white hot billet is pierced by rolling it over a mandrel.

Tubes for many boiler applications are also made by a continuous welding process. Steel strip of required width and thickness is fed continuously into a series of rolls, where it is gradually shaped into a tube. The seam passes beneath an automatic machine which actually fuses the edges together.

Boiler tubes are made to many diameters, generally ranging from the one-inch tubes used in many marine boilers, to four-inch or larger for some utility boilers. Thicknesses of tubing are governed by the pressure to which they will be subjected, and manufacturing processes are geared to maintain very close tolerances.

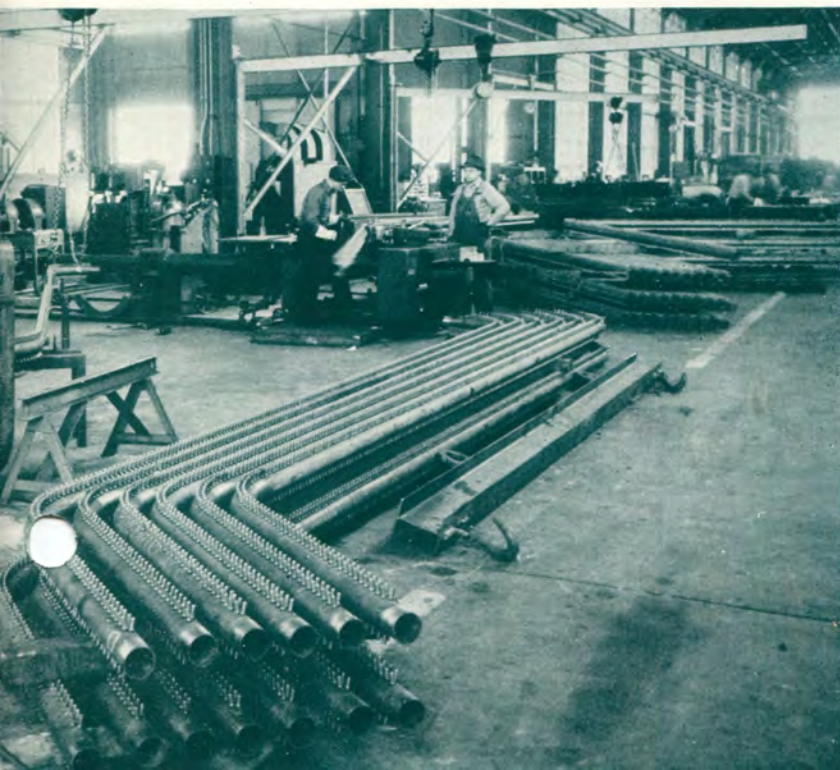
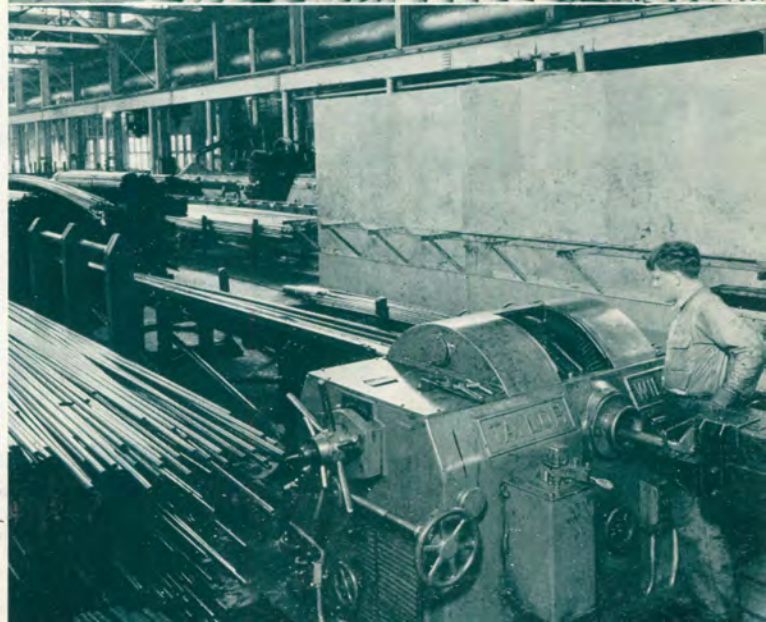
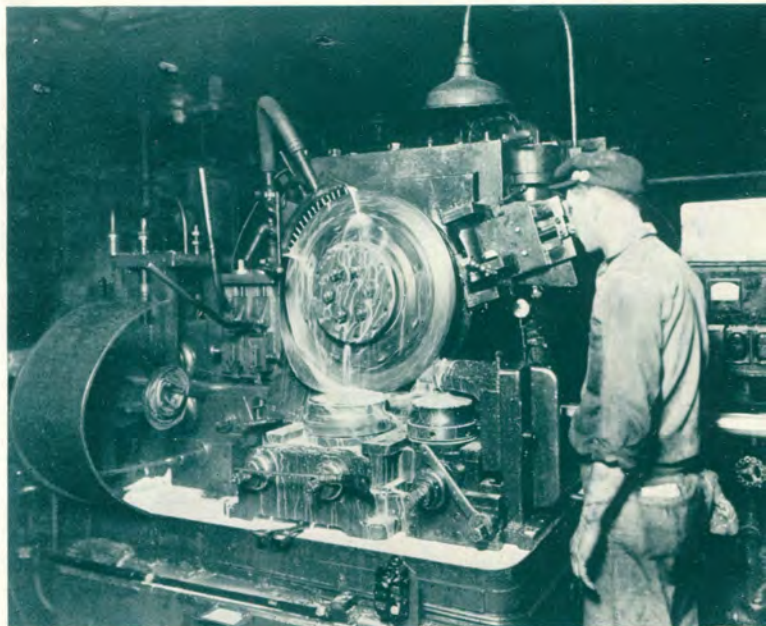
Depending on the specifications to which the tube is fabricated, it is subjected, after rolling, to a number of finishing processes. The tubes are under continuous scrutiny at every stage of manufacture to maintain the highest possible quality, and all tubing receives thorough inspection before being passed.

To simplify erection, tubes are bent to the required shape before shipment. These often take intricate forms, requiring considerable care to insure that the finished tube will fit with a minimum of adjustment in the field.

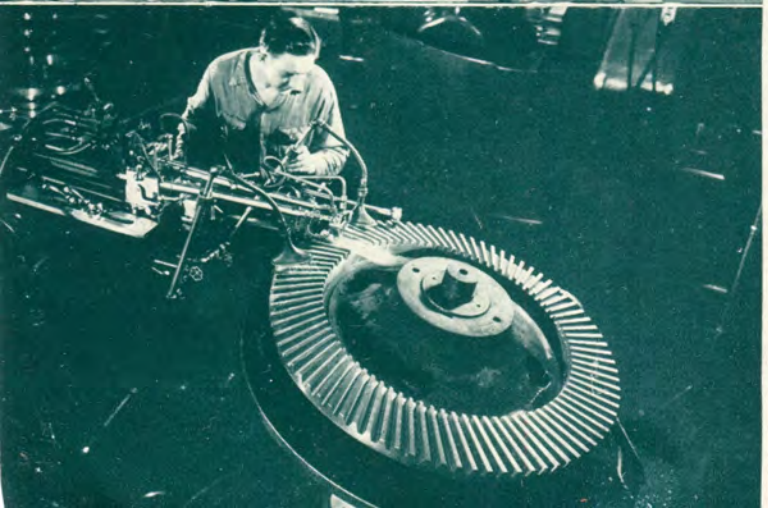
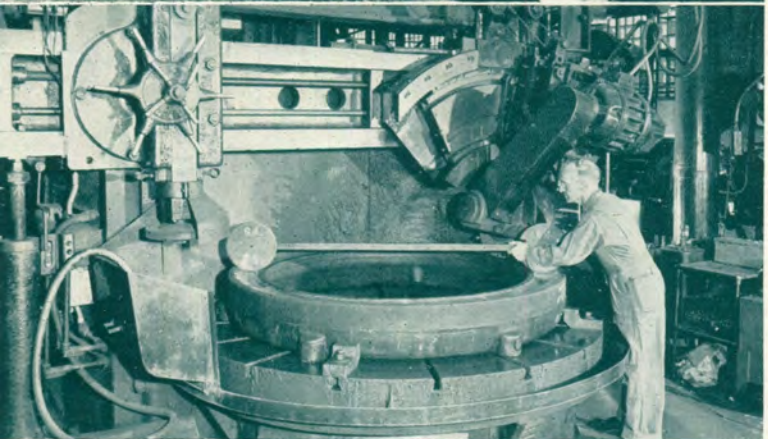
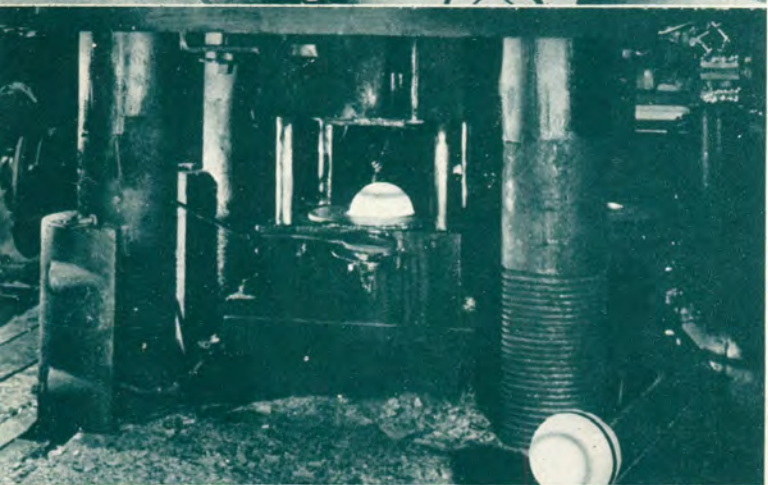
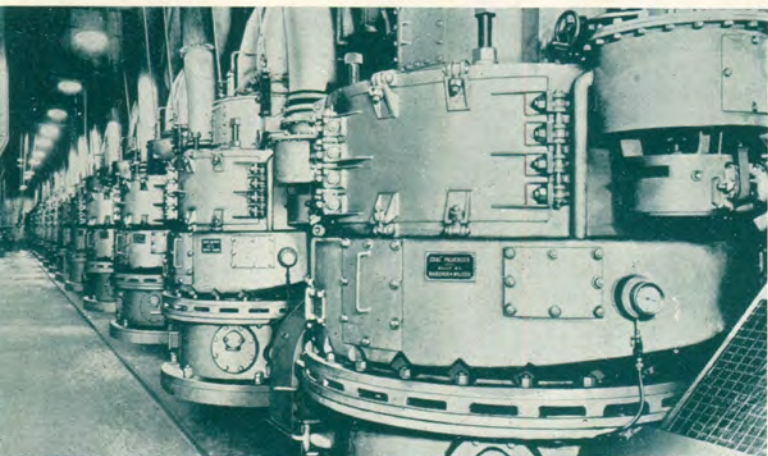
ILLUSTRATIONS: (top to bottom)

- Manufacturing electric-welded tubing
- Tube inspection and shipping
- Tube finishing machine

(Below)—Bending studded tubes



Coal Pulverizers and Cyclone



A large share of the steam generated in America comes from boilers fired by coal, and for medium and large boilers, pulverizing is the method generally used to prepare coal for combustion.

A pulverizer must grind coal to the fineness required for prompt ignition and complete combustion. Also, coal may come to the pulverizer drenched with rain or saturated with moisture from snow and ice, and a pulverizer must dry it out properly so that the coal will flow smoothly.

While bituminous coal may appear soft to the touch, grinding tons of it hour after hour, day in, day out, to talcum powder fineness, wears out tough steels. It is essential therefore that the best available alloys be used and a set of pulverizers for one power boiler may require as much as fifteen tons of chromium-nickel alloys.

Huge gears drive the pulverizer and their teeth are precisely machined. They are also given a hardening treatment to toughen them up for their difficult task.

The balls which grind the coal are held in place by rings. Both balls and rings are subjected to great stress and wear. The balls are forged to spherical shape and

ILLUSTRATIONS: (top to bottom)

- Battery of coal pulverizers
- Forging steel balls
- Polishing pulverizer ring
- Flame-hardening gear teeth

(Below)—Assembling pulverizer



Furnaces are rugged

passed through a series of finishing operations, including a special hardening process. The rings are alloy castings, and must be carefully machined and hardened.

All units are shop assembled and given a complete test to insure proper integration of their many components. Whenever their size permits, the pulverizers are also shipped assembled.

The Cyclone Furnace is used to fire many boilers. It handles coal that is merely crushed, not pulverized. It is noted for its ability to handle poor grades of coal with high ash content, while trapping most of the ash and preventing it from going up the stack. Depending on its size, a boiler will have two or more Cyclone Furnaces.

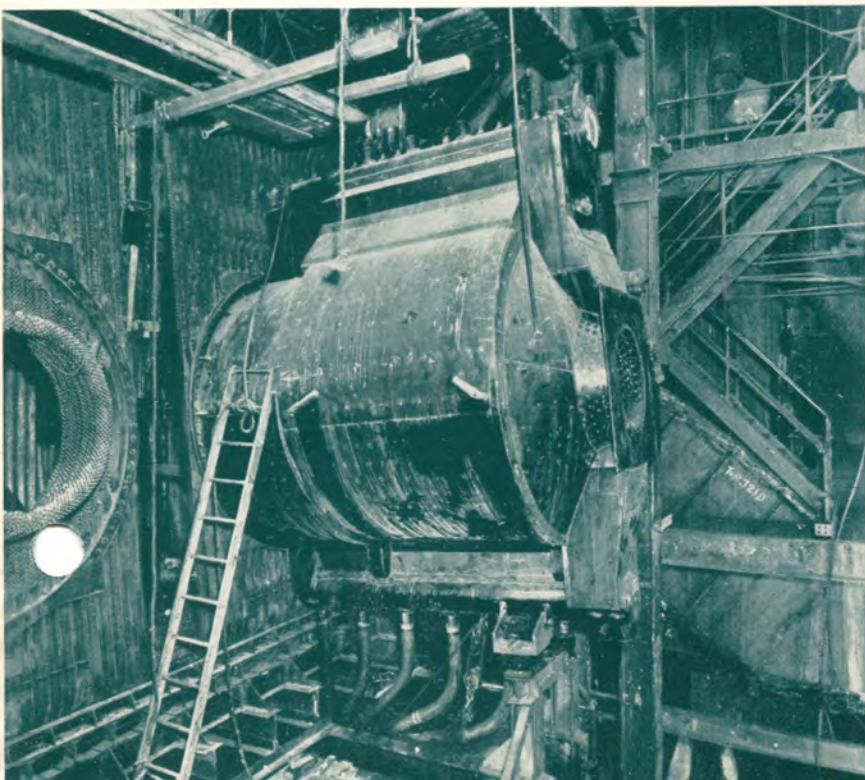
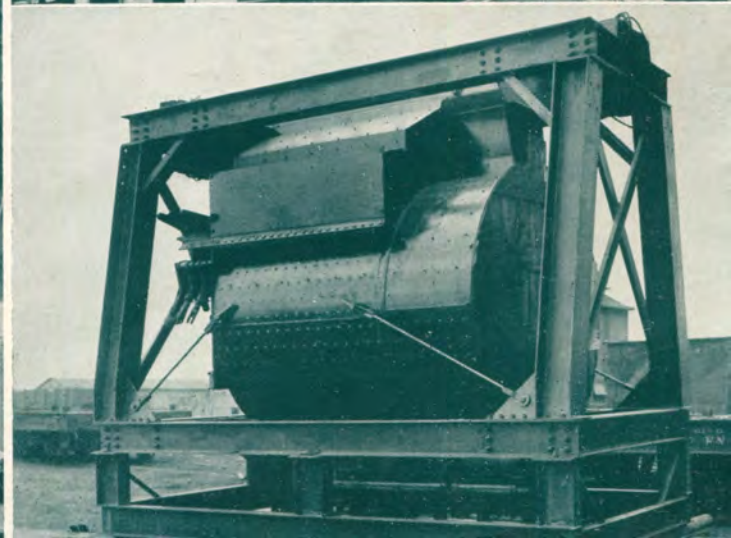
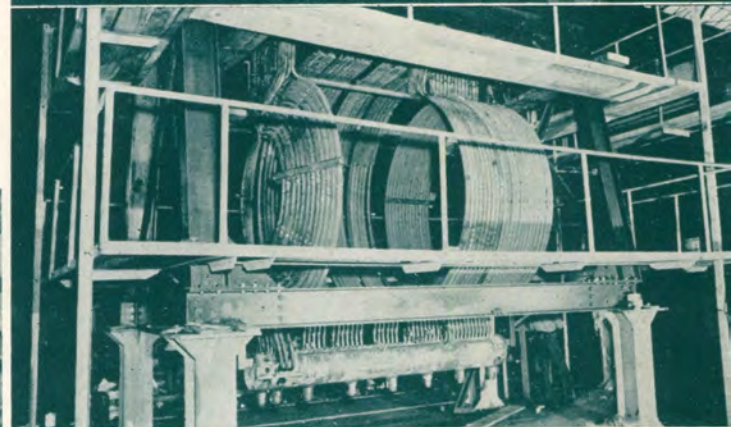
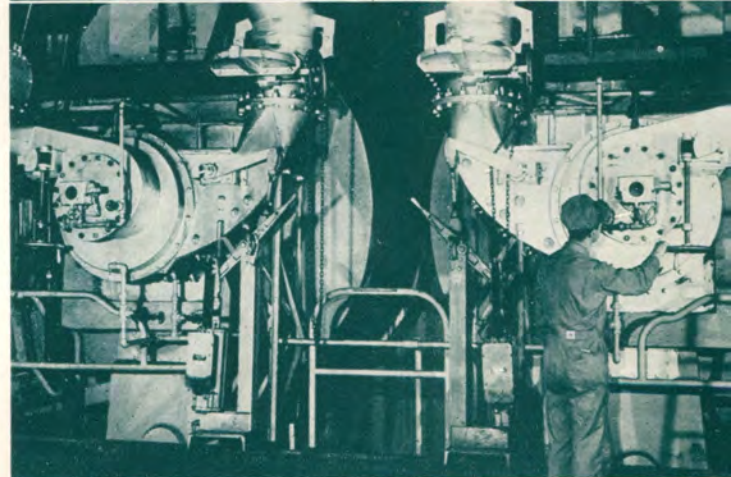
The Cyclone Furnace is cylindrical in form, being made up of many water cooled tubes. The coal is whirled into the furnace and impinges on a coating of molten slag, where it is burned in a stream of air rushing over it at a speed of 200 miles per hour.

Tubes for the Cyclone Furnace are bent accurately to shape. Tubes are assembled in the shop, and insulation and casing applied. Each Cyclone Furnace is shipped complete, ready for field attachment.

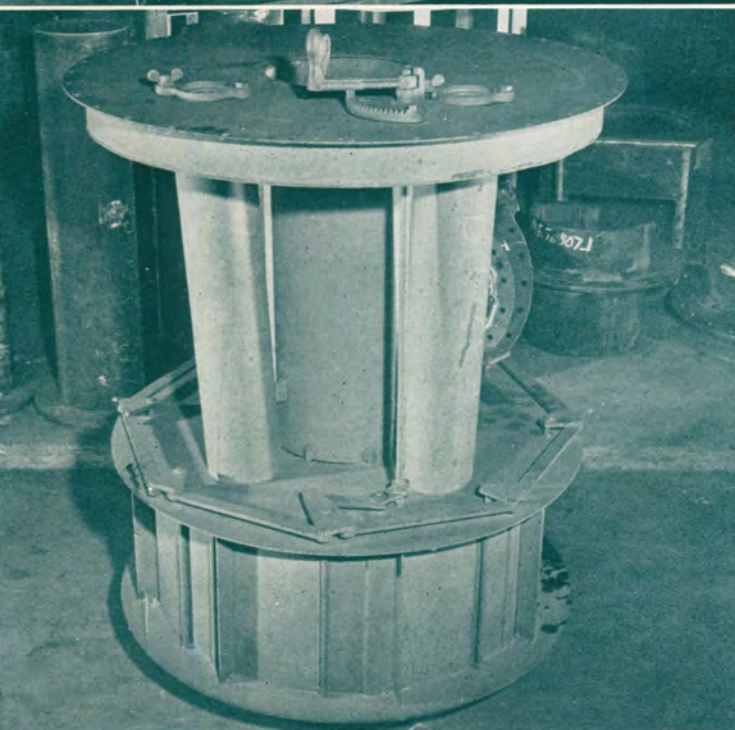
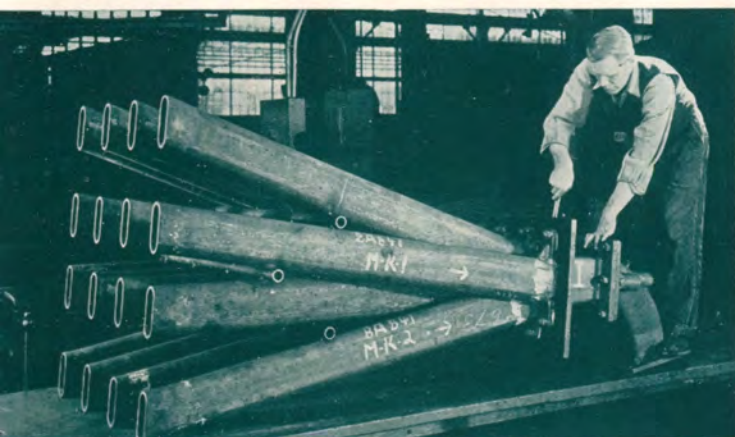
ILLUSTRATIONS: (top to bottom)

- Pulverizer assembly room
- Operating Cyclone Furnaces
- Assembling Cyclone Furnace in shop
- Shipping Cyclone Furnace

(Below)—Installation of Cyclone Furnace in the field



Other components are



Burners, headers, cyclone steam separators, castings, casings, structurals, sprayer plates, impellers, welding rods, expanders, nozzles, baffles—and plain nuts and bolts—a constant flow of materials goes through the shops as the infinite variety of boiler parts is fabricated.

Fuel burners are of different types, depending on the design of boiler in which they will be used. They consist of many parts, all carefully integrated to achieve one purpose: intimate mixing of fuel and air for most efficient combustion. There is very little fuel wasted in the modern burner. Materials used are carefully selected, since the burner is near the hottest combustion zone.

Burners are assembled and their functioning tested before shipment.

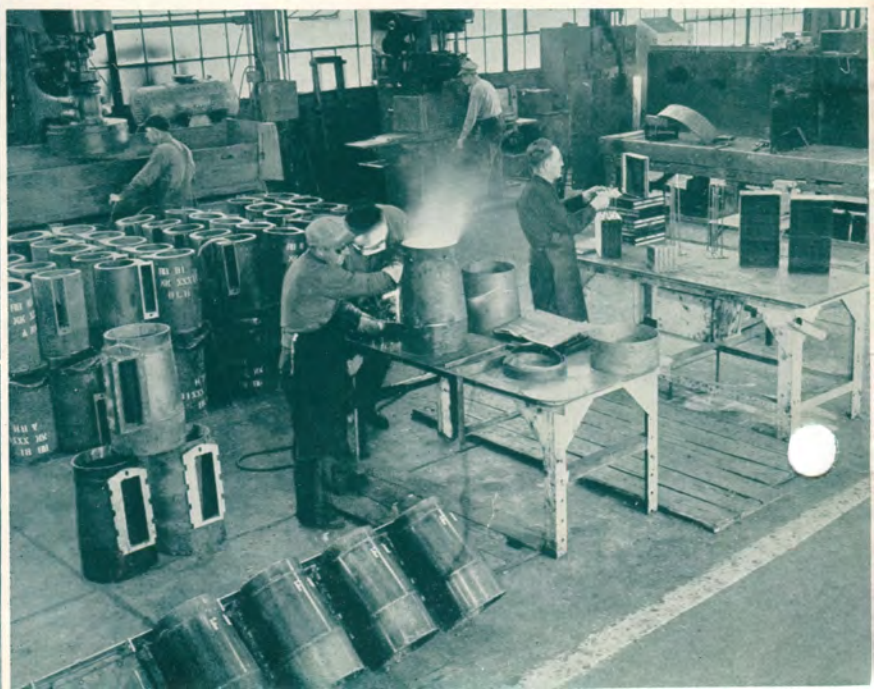
When burning oil, it is necessary to break it up into a fine mist. This is usually accomplished by forcing the oil at high pressure through small slots and holes in a sprayer plate, one of the smallest but most vital parts of many boilers.

Any structure as large as a boiler requires special attention to its supports and stability. Supporting most large units from overhead, leaving them free to expand downward, has been found to be economical. Large beams are necessary for support and many tons of structural steel are used as buckstays, to reinforce the structure. Giant U-bolts and hanger rods must also be fabricated on schedule, because erection cannot proceed until they are in place.

ILLUSTRATIONS: (top to bottom)

- Assembling Multiple-Intertube Burner
- Completed Circular Multifuel Burner
- Drilling sprayer plate
- Checking structural steel

(Below)—Fabricating cyclone steam separators



built to schedule

Many large pipes called "headers" are used in boilers and their components. A header serves as a gathering point for any system of tubes. For example, the tubes making up the walls of the furnace terminate in headers at the top and bottom. Similarly, superheater and economizer tubes need headers to serve as distributing and gathering points. Piping and headers for superheaters are often made of chromium-molybdenum alloy steel to withstand the high temperatures used. Stub ends of tubes are sometimes attached to headers in the shop to simplify welding in the field.

Even the fabrication of welding rods must be planned since many parts of the boilers are welded together in the field. Some jobs require as much as 50,000 pounds of welding rods. Welding rods are made of alloys similar to the material which they will be used to weld together so that the completed piece will have uniform characteristics.

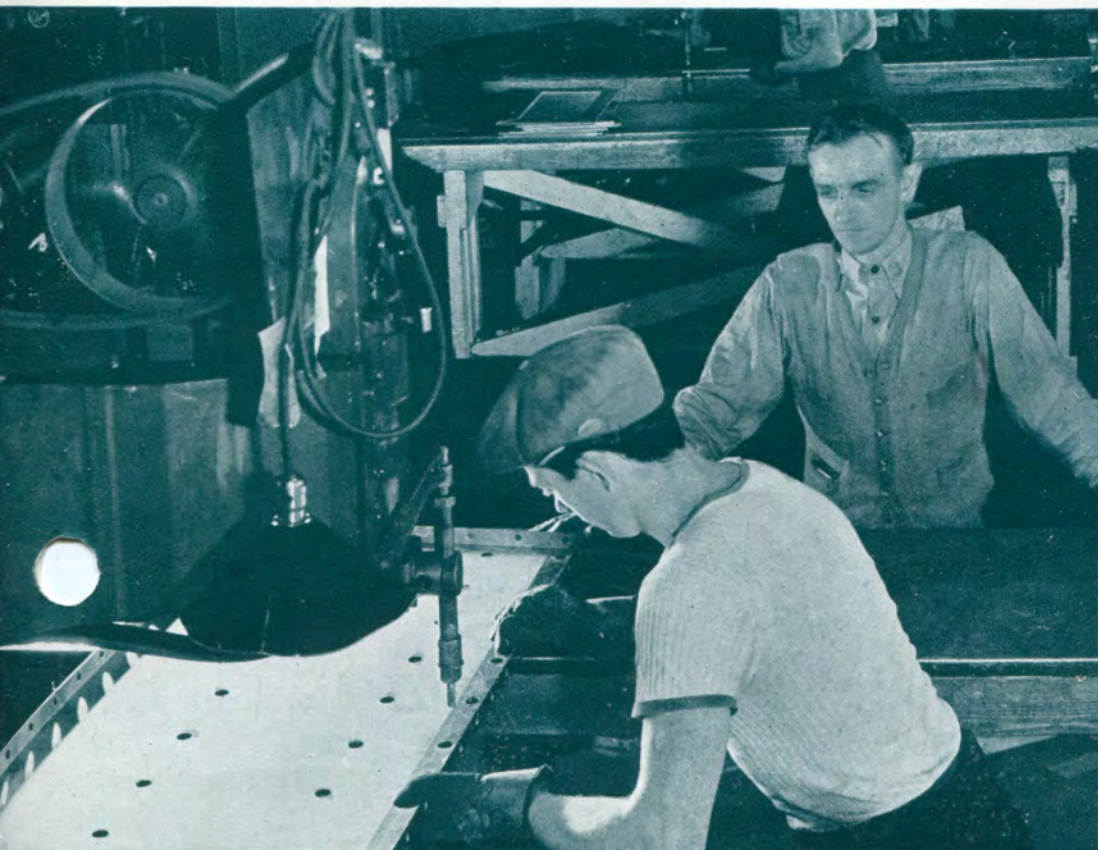
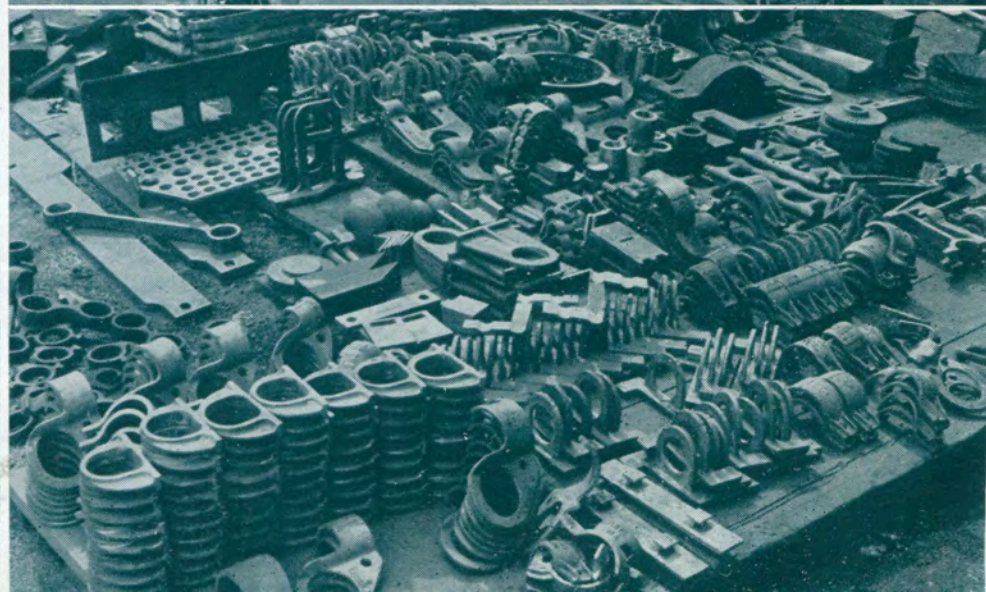
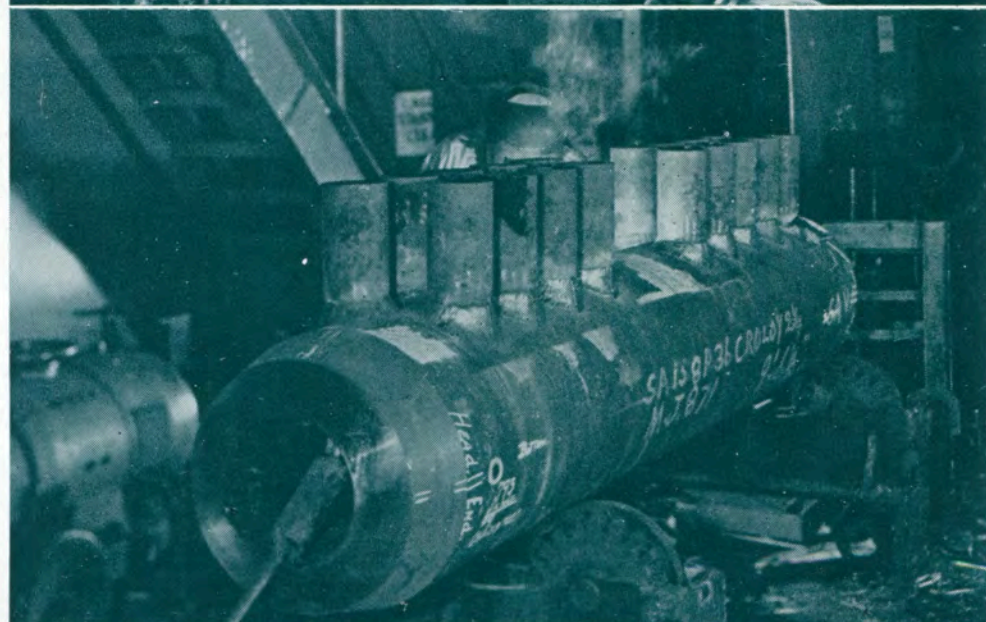
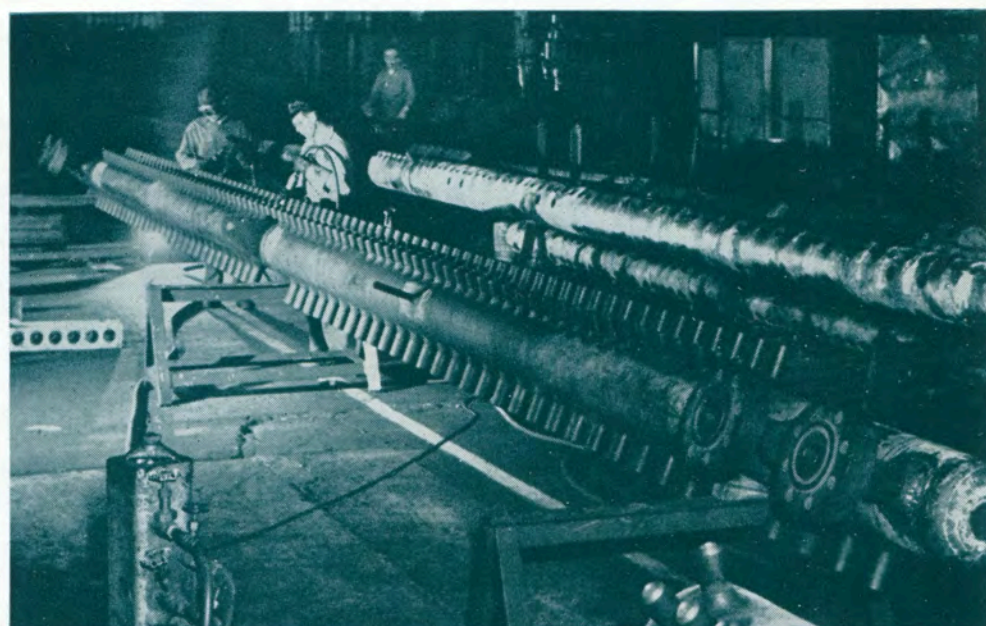
Alloy castings are used to support boiler components, such as superheater tubes, which are located in high temperature zones. Many burner parts are also made of heat-resistant castings. A fair-sized power boiler will need as much as 10 tons of chromium-nickel alloy castings, as well as considerable quantities of steel and iron castings.

Boilers are often supplied with steel casings when necessary to restrict leakage of air into the unit or of gases out of the furnace. Casings are made of thin gage steel and are prefabricated so that a minimum of field work will be required.

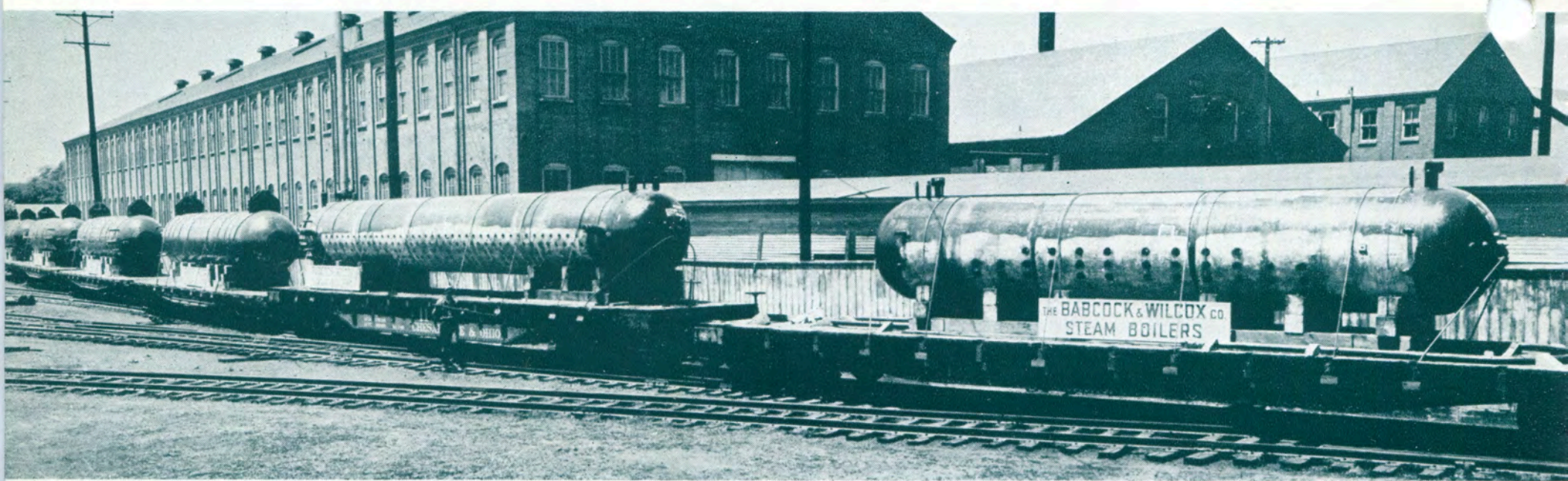
ILLUSTRATIONS: (top to bottom)

- Cleaning and inspecting headers
- Superheater-outlet connecting piping
- Packing welding rods
- Boiler and superheater castings

(Below)—Drilling Casing



Carloads of parts are

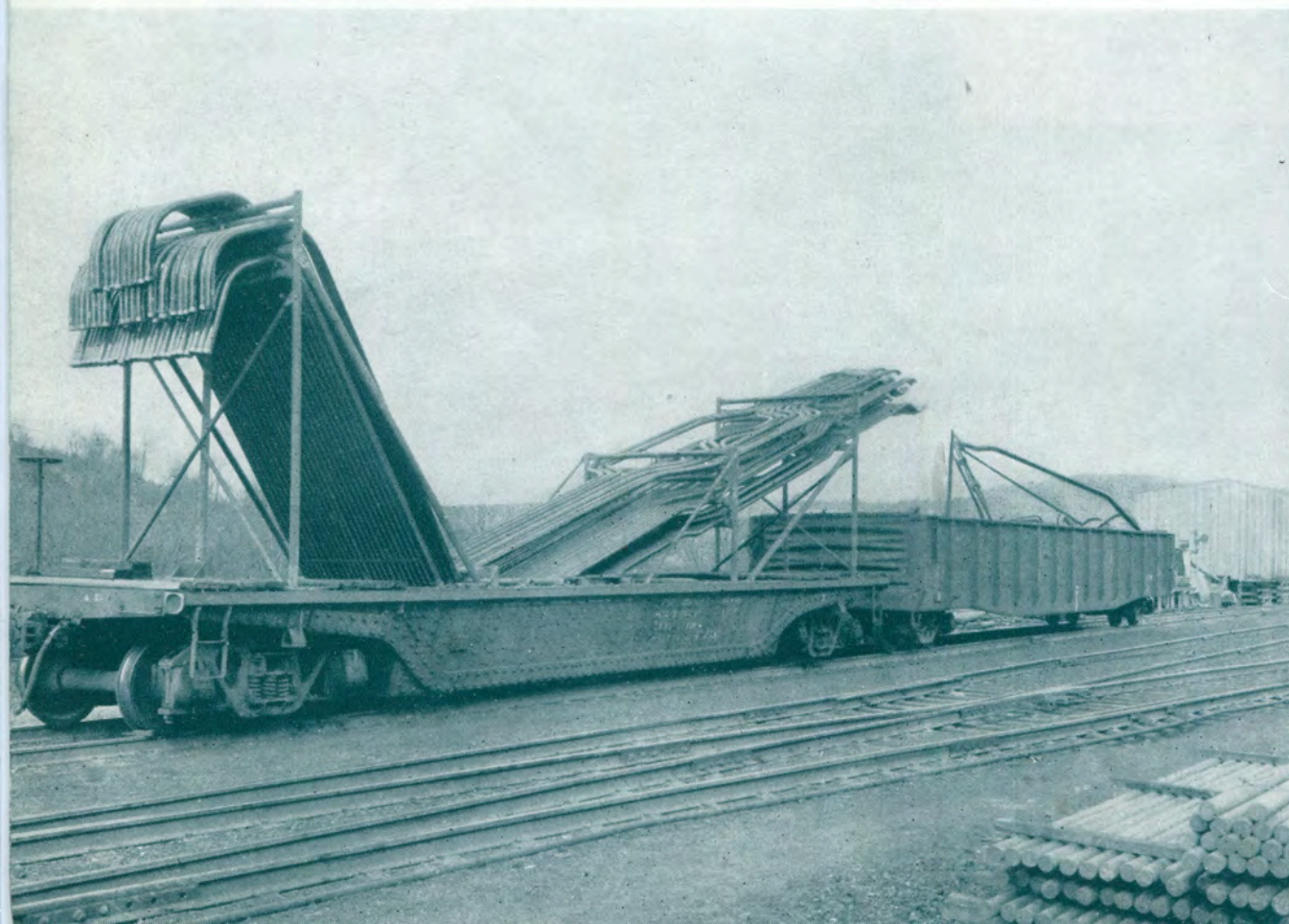


Shipment of steam drums

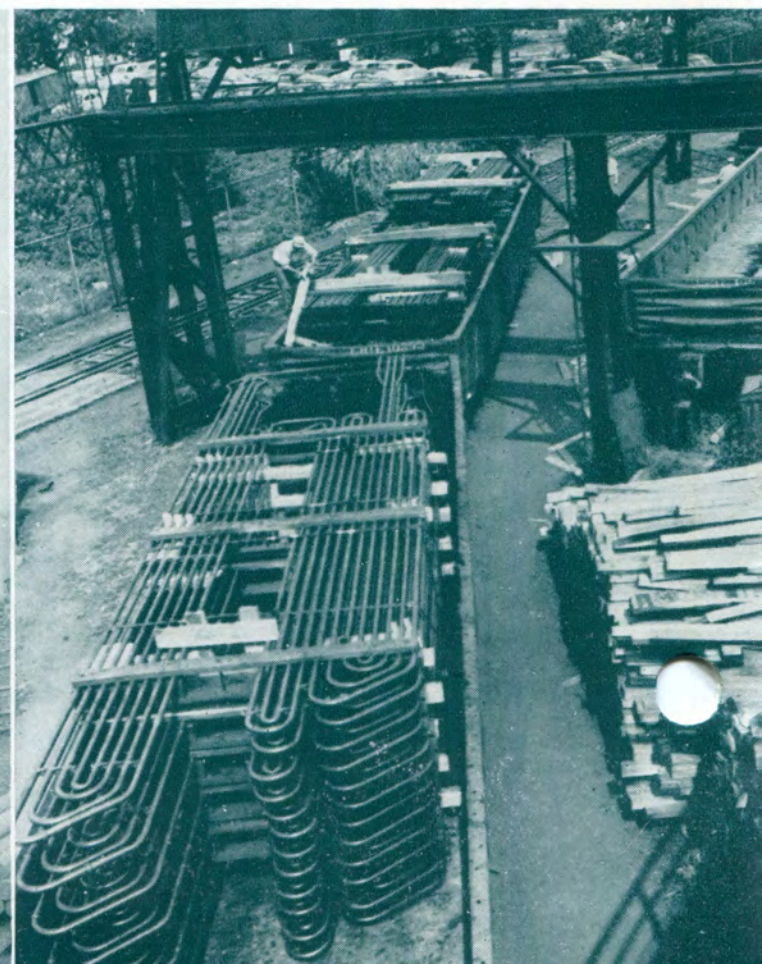
Some boilers are so small that they are shipped from the works, completely assembled, on one freight car. More often, a great many carloads of parts must be shipped—as many as 150 carloads for one large power boiler. Long, heavy steam drums take up a car apiece, and often require special cars. Tubing, which has been bent to shape and assembled into components, often

projects high above the road bed. Clearances on curves, bridges, tunnels must be checked before the route for a shipment can be selected. The materials come from many shops and many cities, in a great stream, and the problem of coordinating and scheduling so that equipment arrives at the proper time for efficient erection is the subject of considerable planning.

Furnace tubes on flat car



Loading superheater sections



shipped and erected

Handling the massive steam drum—from the moment its fabrication begins until it is finally in place—is an exacting job. Its journey is carefully planned, and equipment to move it must be on hand where and when necessary.

After the necessary supporting steel is in place, the steam drum is raised in a tilted position to clear the framework. It moves up inch by inch, dwarfing the men who are supervising the job.

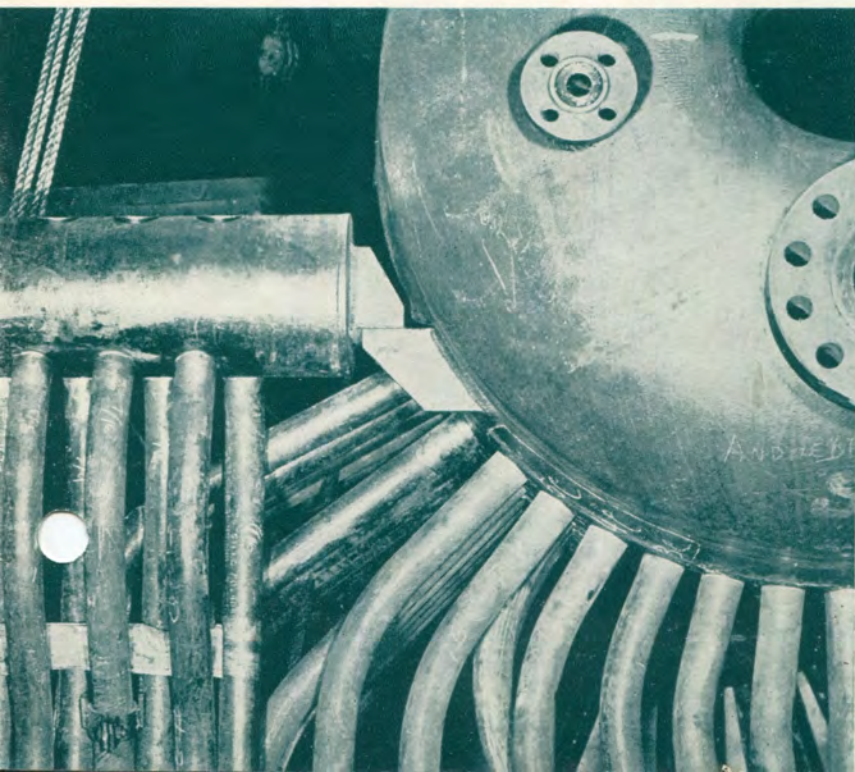
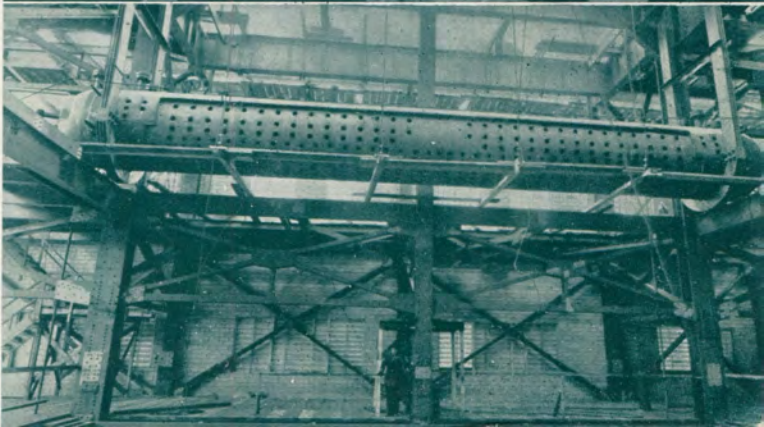
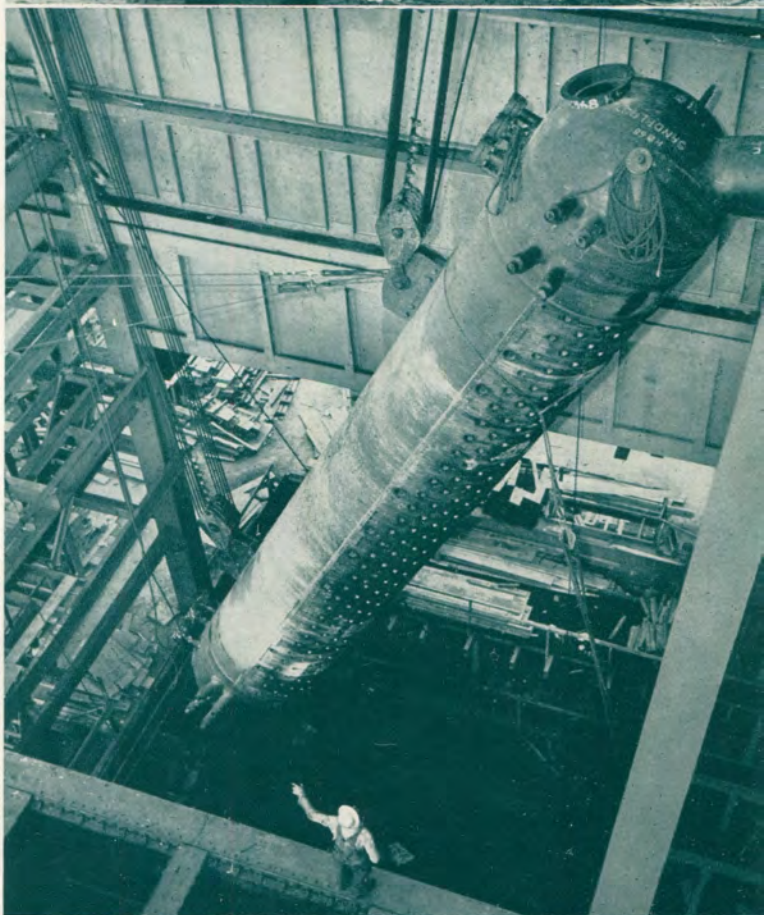
When it reaches its final position, often 100 feet above ground level, it is leveled off, and giant U-shaped steel hanger bolts are raised into place at both ends, forming the permanent supports for the drum.

Once the drum is aligned, the job of installing tubes begins, and the drum quickly becomes the focal point for an intricate network of tubes and headers.

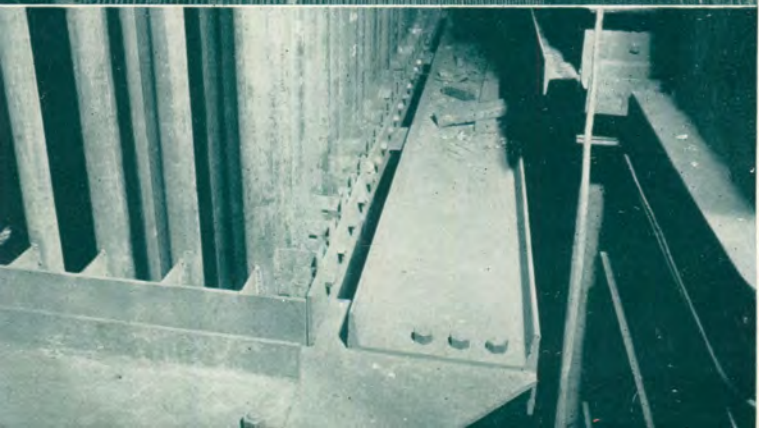
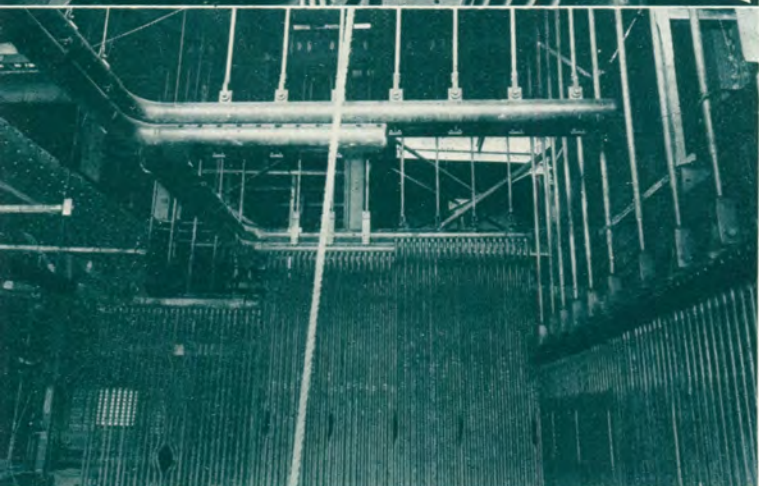
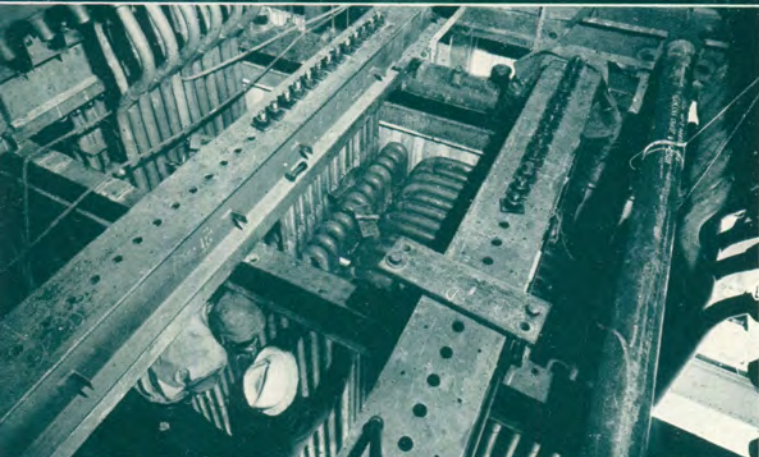
ILLUSTRATIONS: (top to bottom)

- Moving steam drum in transit
- Raising drum in tilted position
- Drum leveled off

(Below)—Installation of tubes and headers



Thousands of items must be



Inside the drum, the tube ends are expanded to form a tight joint with the seat. This joint must be tight against the high pressure at which the unit will operate, and will be subjected to hydrostatic tests that are half again as great—often over 3000 pounds per square inch. The tools and methods used for this vital operation are the results of years of experience and development.

Like a massive jig-saw puzzle, piece after piece is fitted into place. Proper sequence of erection is essential. For example, superheater tubes cannot be installed until superheater headers are in place, and headers, in their turn, must await installation of their structural supports and hangers.

As the boilermakers, iron workers, steam fitters, millwrights, electricians, machinists, bricklayers, and many other craftsmen go about their work, the boiler begins to take shape. Each of the hundreds of tubes is installed, fitted, and expanded. This is where careful attention to detail at every previous stage—engineering, design, scheduling, fabrication—pays off in countless ways.

Because of their great length, tubes tend to be flexible. Steel buckstays are thus used for reinforcement.

Welding of pressure parts plays an important part in boiler erection, and calls for men with special qualifications. Without the development of field welding as a means for examining welds, the large modern boiler would not be practical.

ILLUSTRATIONS: (top to bottom)

- Expanding tubes into tube seats
- Superheater installation
- Furnace walls
- Steel buckstays

(Below)—Field welding piping



fitted together

Working space is often restricted, and as the network of tubing grows, considerable ingenuity is needed to get at the various parts, fit remaining pieces into place, and do the necessary work of welding, bolting, expanding. But boiler erection men are old hands at the job of licking tough problems, and are justly proud of the records they have made in erecting the thousands of boilers needed by an ever-growing America.

The economizer, a bank of compactly arranged steel tubes, preheats water before it enters the steam drum. After assembly in the field, the tubes are welded to stubs in the headers.

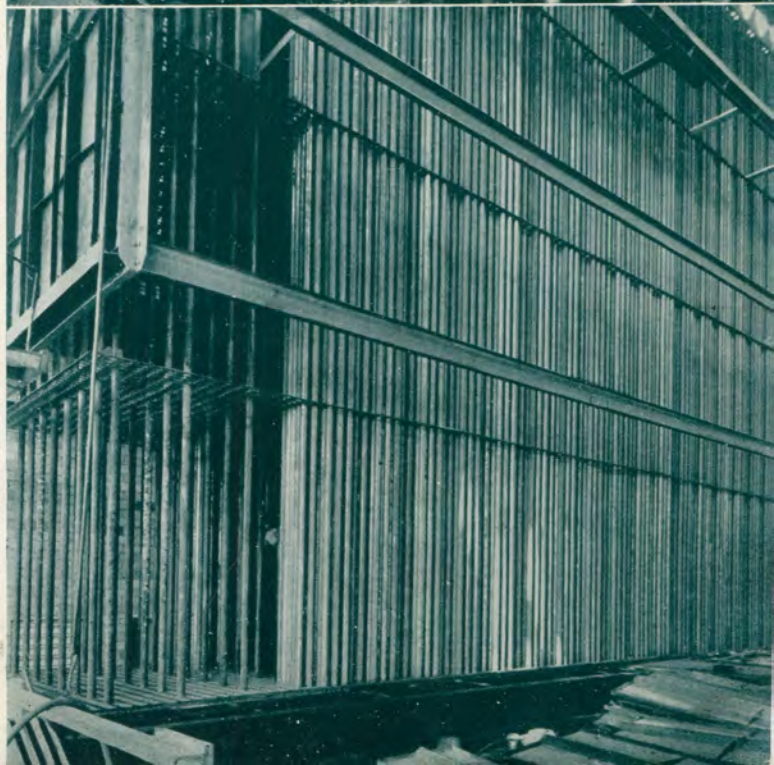
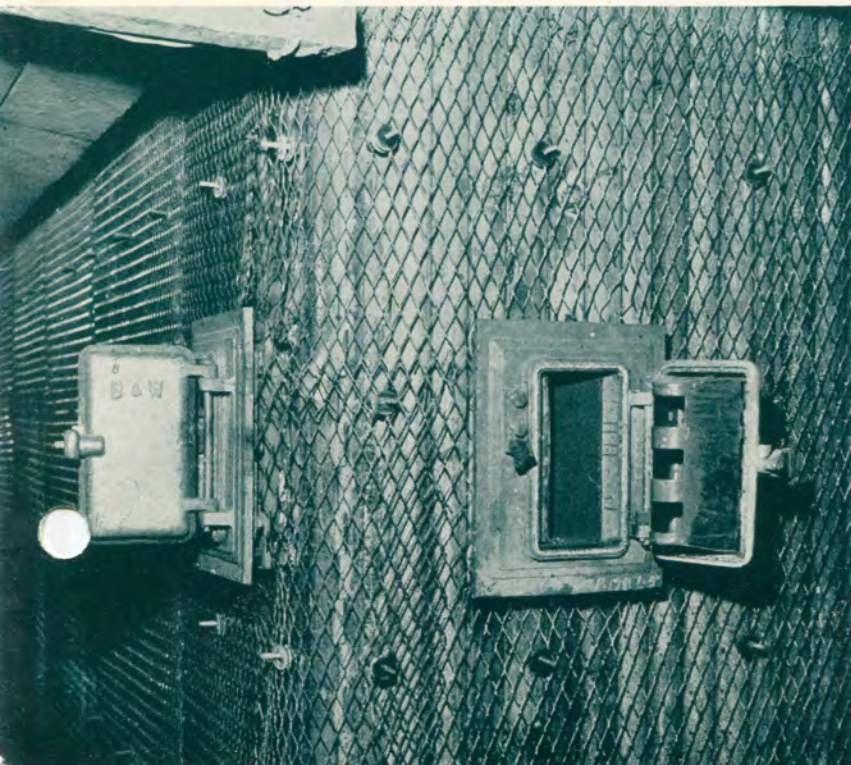
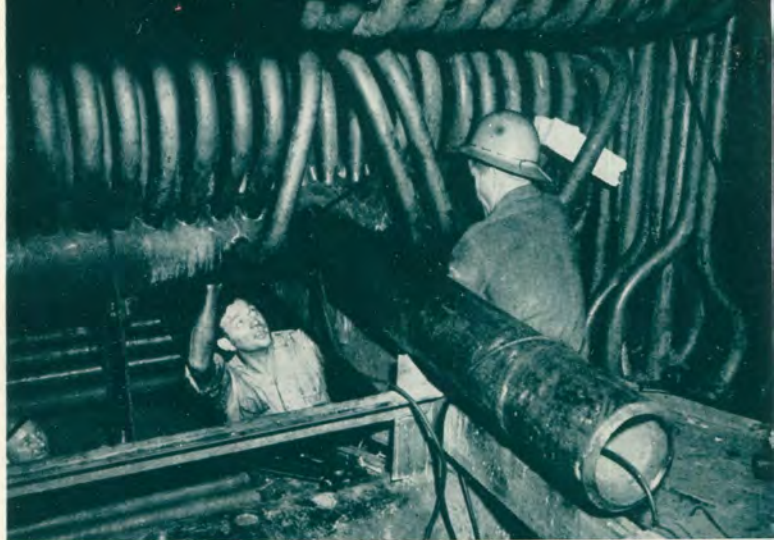
It is not unusual for an air heater to contain over 300,000 square feet of heating surface. Flue gas, on its way to the stack, flows through the air heater tubes, while air for combustion is blown across the tubes. This reclaims heat that would otherwise be lost, and the hot air makes for more efficient combustion of the fuel. The greater portion of the air heater tubes is made of steel. However, aluminum tubes may be used in certain locations to minimize corrosion.

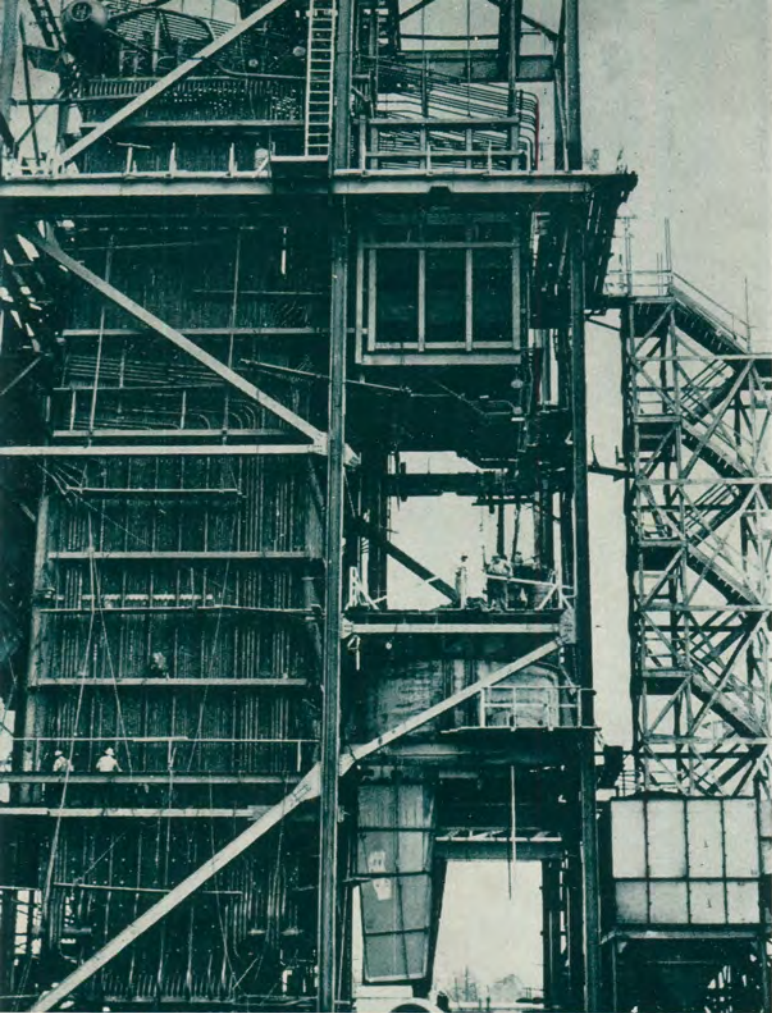
The boiler tube-walls are covered over with refractory and insulating materials and a finish coat is applied over metal lath. The finished unit is practically gas and air tight. If the furnace is to be operated under pressure, a thin skin of steel casing will be placed next to the tube wall before the insulation is applied.

ILLUSTRATIONS: (top to bottom)

- Furnace wall headers and tubes
- Welding economizer tubes to header stubs
- Erection of air heater

(Below)—Furnace walls ready for insulation



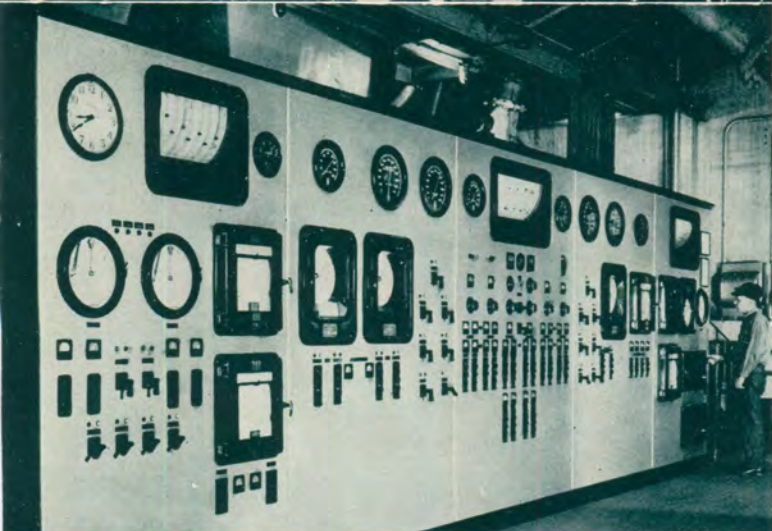


Our needs for the things that make us great a nation continue to expand and the demand for steam is growing at a prodigious rate. Plants are springing up in many parts of the country, and older plants are being enlarged or modernized. Often, several boilers are erected at one time, and three shifts of erection crews may be required day after day, week in, week out.

As the unit nears completion, work is speeded on all other parts of the plant—turbines, condensers, pumps, fans, heaters, piping, controls, transformers—an endless list of materials, coming from all kinds of industries in all parts of the country, all fitting together in one giant mechanism.

Immense amounts of energy—tens of thousands of horsepower—will be released and harnessed in a single boiler-turbine unit, and every single item must be as perfect as the knowledge and skill of man can make it.

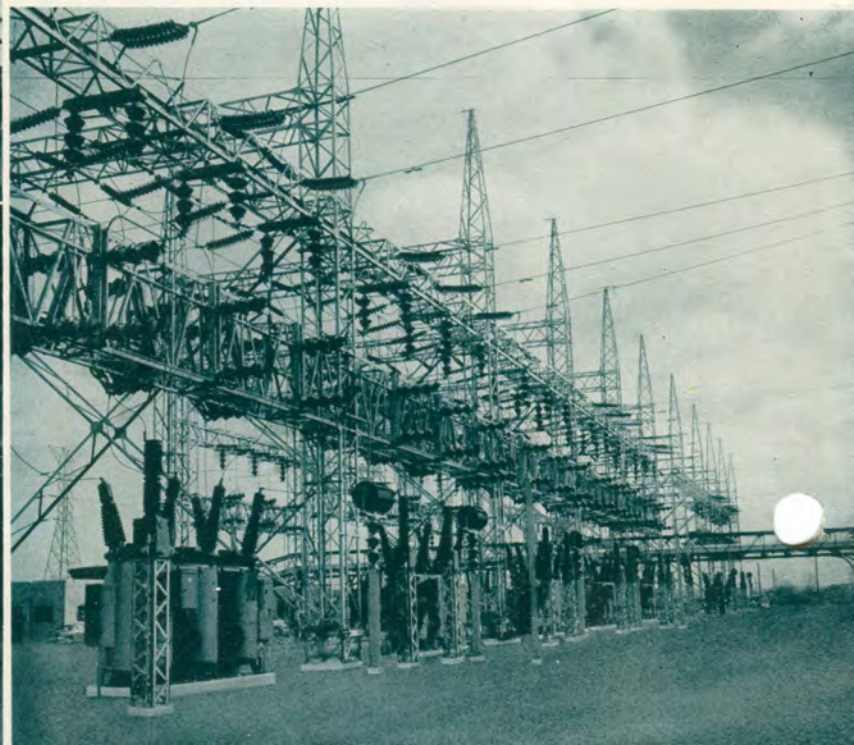
A steam plant is thus the product of a thousand skills, calling for the highest degree of cooperation and understanding among engineers, technicians and artisans from many industries. That America has never yet lacked for steam—whether for power or industrial processing—is a tribute to their skill and foresight.



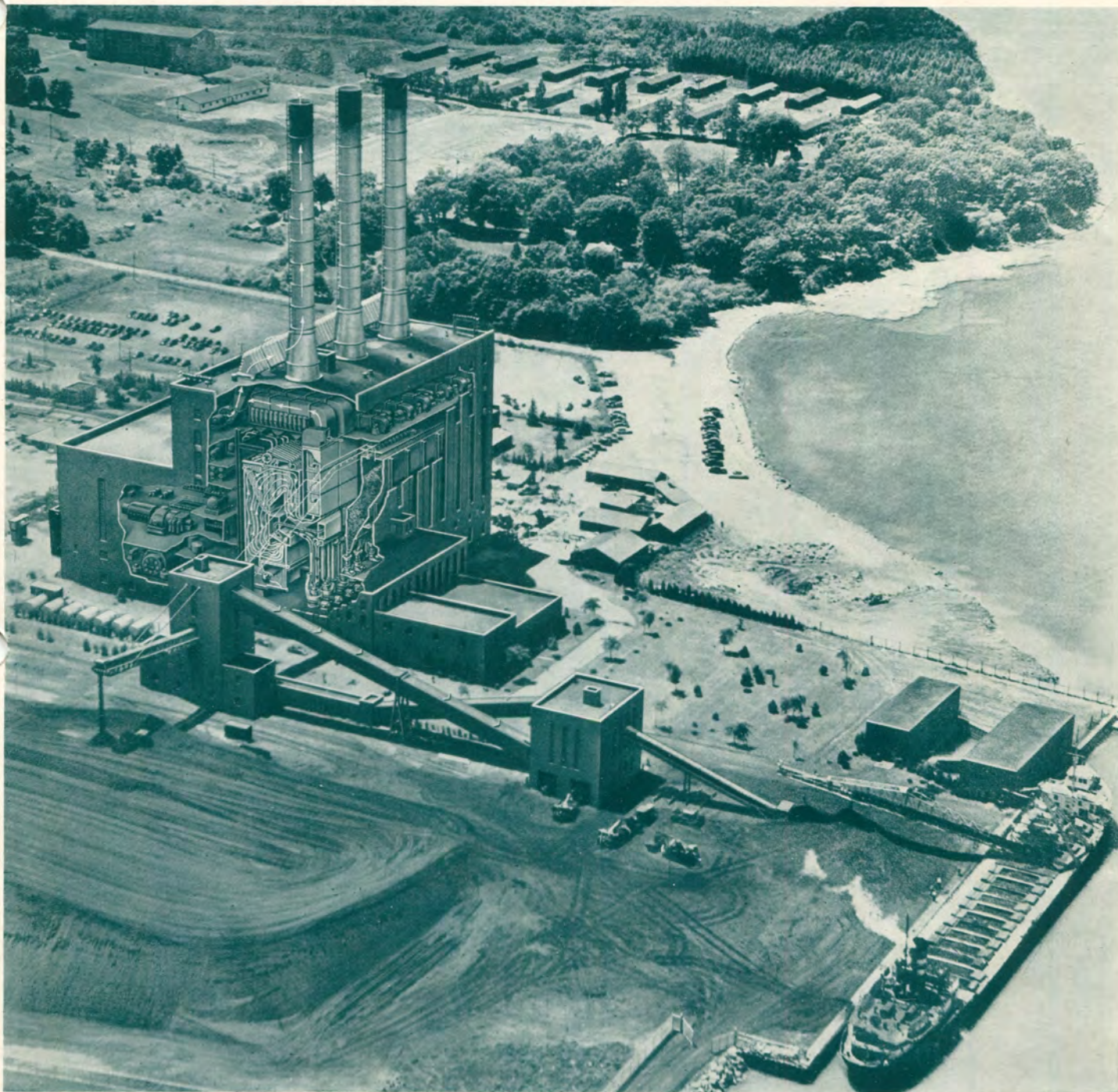
ILLUSTRATIONS: (top to bottom)

- Erection of outdoor boiler
- Central station control room
- Large turbine installation

(Below)—Power plant switch yard



Serving America



Steel, nickel, copper, aluminum, chromium, molybdenum, cement, and many more—thousands and thousands of tons of raw materials: here they stand now, after years of planning and work, shaped by the imagination of men into a mighty instrument of service.

In panorama, we can see the drama of steam generation for production of electrical power. From the collier at the dock, coal pours in a steady stream over conveyors to the massive storage pile. Bulldozers push

hundreds of tons per hour into great conveyors, which carry the coal to the bunkers, whence it flows by gravity into the pulverizers. The powdered coal is blown into the furnace, where it burns and releases tens of thousands of horsepower every hour. This wild energy is harnessed by the steam and rushes through pipes to the turbo-generator, forcing it to whirl at great speed, producing the electrical power that flows to farms and cities, to home, commerce and industry—to the heart of our nation.

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***Note:** Those who desire more information on the story of steam may be interested in the educational films **STEAM FOR POWER** and **STEAM POWER FOR AMERICAN SEA POWER**. These may be obtained through The Babcock & Wilcox Company at 85 Liberty St., New York 6, N. Y.*